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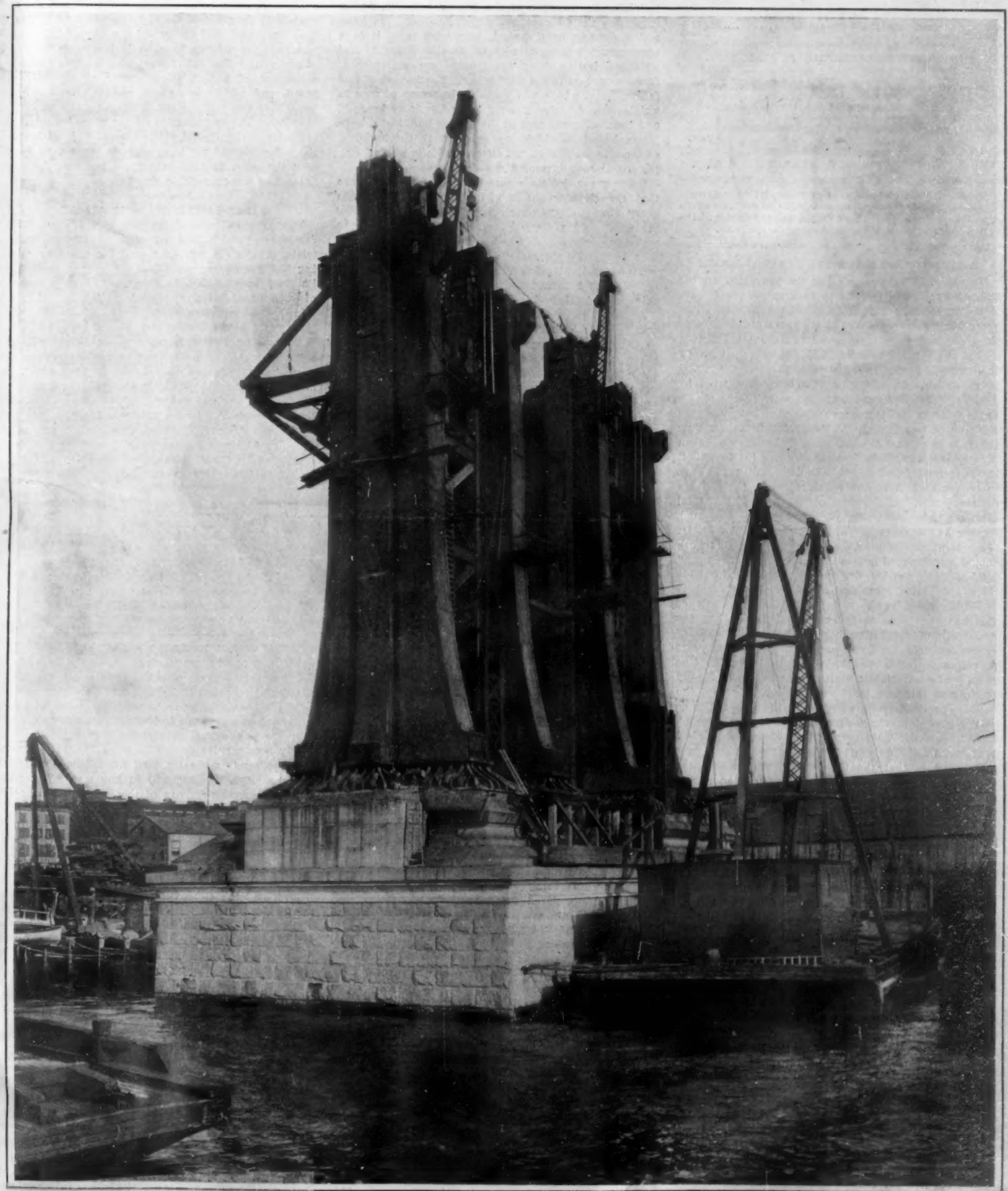

Each of the Four Legs Measures 5 Feet by 32 Feet at the Base and 5 Feet by 10 Feet at the Top. The Towers Will Rise 322.5 Feet Above the Water. The Side Spans of the Bridge Will Be 725 Feet Long and the Main Span 1,470 Feet. The Total Weight of Steel Will Be 42,000 Tons. The Wires of the Four Cables Will Have a Total Length of Over 28,000 Miles, or Nearly Sufficient to Girdle the Earth.

THE ERECTION OF THE GREAT STEEL TOWERS OF THE MANHATTAN SUSPENSION BRIDGE, NEW YORK.—[See page 77.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, FEBRUARY 1, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A YEAR'S PROGRESS ON THE PANAMA CANAL.

The progress of work during the year 1907 on the Panama Canal was such as to confirm the recent estimate of Secretary Taft and Colonel Goethals that this great work will be finished in six years' time. During the past twelvemonth there was excavated along the line of the canal a total of 16,764,095 cubic yards. Of this amount, about 11,000,000 cubic yards was removed by steam shovels, and over 4,800,000 cubic yards by dredges. The greatest results, of course, were shown in the Culebra division, from which alone over 9,000,000 cubic yards was taken out. According to figures published in the Canal Record, when the work was taken over by the Americans from the French in May, 1904, it was estimated that 57,600,000 cubic yards would have to be removed from the canal prism in the Culebra division alone. At the close of last year, of that total amount, 12,800,000 cubic yards had been excavated, leaving 44,800,000 cubic yards still to be removed. If the present rate of progress can be kept up, this work should be completed in less than five years. The grand total of all excavation, dry and wet, inside and outside the canal prism, completed since we took control, is 22,758,291 cubic yards, and practically the whole of this has been done since January 1, 1906, when the real work of excavation began. The total work of excavation done by the French during their ten years of active operation was 81,548,000 cubic yards. The amount of excavation in a given time has been steadily rising, and this is a most encouraging feature of the work. For the first time on record, the 2,000,000 cubic yard limit of monthly excavation was reached and, indeed, passed. This occurred in December of last year, when 2,200,539 cubic yards was removed. It now seems certain that the Culebra cut will not be the determining factor in the time of completion of the canal, but rather the vast and difficult work of building the Gatun dams and locks.

THE LESSONS OF THE PARKER BUILDING FIRE.

It will be unfortunate if the burning of the Parker building in New York serves to shake the faith of the public in genuine, up-to-date fireproof construction. It will also be unfortunate if this fire fails to teach the public that fireproof construction, if it is to withstand fire, must be what it purports to be, and not the kind of ineffective makeshift which burned up so completely in this twelve-story building. There is no such thing as near-fireproof. A building will either burn and be gutted, or it will not. It is not sufficient to say of a building that its component parts are incombustible; for incombustible materials may be so put together that, under the attack of a fierce fire, they will lose their cohesion, and the whole mass will inevitably come down, either piecemeal or in one general collapse. We are informed that the reports of the engineers and fire experts who have examined the Parker building, show that the structure was of that altogether too numerous class which by courtesy is called fireproof, but which actually offers but little protection for the contents, and, should the fire gain more than a certain amount of headway, is damageable all the way from five per cent to ninety per cent of its cost value.

There is a broad difference between the admirably-constructed skyscrapers of New York or other really fireproof buildings of the first class and the semi-fireproof class to which the Parker building belongs. The outer walls of this structure were of stone, brick, and terra cotta; its skeleton was of cast-iron columns and steel beams with a floor tiling of fireproof hollow tile. But the floor system presented the absolutely inexcusable defect, so common in many buildings put up a few years ago in this city, of having no protection whatever for the lower flanges of the steel beams and the main girders. If anyone who reads this statement may happen to be engaged in an office or loft, where he can look up and see the bottom flanges of the floor beams and girders exposed to view at the springing of the floor arches, he may set it down at once that he is in a building which is not in any strict sense fireproof, even though the separate materials of its construction are incombustible. The peril of the exposed bottom flange lies in the fact that, if the floor lofts of a building are more or less crowded with combustible material, as in the case of the Parker building, and a fierce fire should once get under headway, the heat, acting directly on the steel, may soon raise it to a temperature where it loses its tensile strength, and stretches, letting down the whole floor of which it forms a part on to the floor below. The impact of this falling mass, which will probably be scores of tons in weight, would probably carry away the floors beneath, and thus, as in the case of the Parker building, a huge internal shaft would be opened through the building, and, under the fierce draft engendered, the whole building would soon become a seething furnace.

Other grave defects reported by the fire experts are that the elevator shafts and stairways opened into every story; that iron shutters of an inferior order protected only a few of the windows; and that the water supply permitted the firemen to reach only to the fifth floor. Furthermore, although the building was put up for light office purposes, it was subsequently occupied as a manufacturing plant, loaded with machinery, and filled with combustible materials.

Although there has been a marked advance in the quality of fireproofing, and the methods of applying it, so that the best types of building used for office and other commercial purposes are probably quite fireproof, there is a call for stricter laws and more rigid enforcement of them in the case of the smaller and less costly type of so-called fireproof buildings, of which such an enormous number is being put up every year in our large cities. The law should demand that every square inch of the steel frame be thoroughly protected from fire, either by hollow tile or first-class cement protection. The various stories must be isolated one from the other by carefully inclosing the elevators and stair shafts; and with a view to preventing the communication of fire from the outside of the building, the external openings should be protected by metal sashes and wire glass. Furthermore, a rigid inspection should be made by competent experts of all the older structures of the Parker building type, and measures taken to remedy, as far as possible, the defects in the fireproofing arrangements. These provisions might include the inclosing of shafts, the protection of windows, and the supplying of water, hose, and fire alarms sufficient to check an incipient fire, and prevent it from making the rapid sweep of the whole building that occurred in the recent disaster.

THE ENLARGEMENT OF THE ASSOUAN DAM.

The changes in the Assouan dam, designed by the ate Sir Benjamin Baker for the purpose of increasing its height and giving it greater mass and strength to resist the increased head of water, were recently made the subject of criticism by Sir William Willcock in a lecture delivered last December before the Khedivial Geographical Society, when he said: "This extra expenditure of time and money for such a trifling result may certainly be classed as one of those unremunerative works against which the State to-day is setting its face like a flint. The additional width of base of five meters is being built, not on a foundation designed and prepared for supporting a massive wall subjected to an ever-varying pressure, but on the apron designed and constructed for insuring a safe flow of water along its surface. This patchwork addition of unhomogeneous masonry is to be tied by countless iron bars to the downstream face of the main dam; and if the new work settles anywhere, as it may do, it is within the range of probability that it will tear off the facework of the dam, which facework, as built, is itself unhomogeneous with the interior masonry of the dam."

Although it is true that the apron in front of the toe of the present dam was not prepared specifically for supporting a massive wall subjected to varying pressures, the character of this construction is such that it is admirably adapted for that very purpose. In the issue of the SCIENTIFIC AMERICAN of July 15, 1907, we gave an illustrated description of the building of this apron, and the solid character of the work is shown in the great care taken in preparing the underlying rock and in building up the rubble masonry upon it. The river bed was first unwatered, and then all the faulty rock was blasted out until the solid underlying rock was exposed. This work entailed some very heavy excavation, which in places was carried down to considerable depths. The whole of these depressions and cavities were then filled up with rubble masonry of a heavy and solid nature, set in 4 to 1 cement mortar, and finally the whole of the work was faced with squared granite blocks laid in a 2 to 1 cement mortar. As this masonry apron extends for some 60 feet from the toe of the dam, it can be seen that it will afford a good foundation for the 15 feet additional width of masonry which is to form the addition to the existing dam. It is true, as Sir William asserts, that the additional work is to be tied by steel bars to the downstream face of the main dam. The object of this is to allow the new work to reach the same temperature as the old work before the final bond between the two is made—otherwise serious temperature stresses might be set up in the dam. After equality of temperature has been reached, the 8-inch space between the old and the new work will be grouted up, and the whole structure as thus combined will be raised by the addition of 7 meters to its existing height. It is outside the range of probability that this 15-foot addition will cause any settlement of a foundation already so carefully prepared, and which has stood successfully the heavy impact of the water passing through the sluices of the dam. The combination of the steel bars and the cement grouting should give an excellent bond between the old work and the new; and we can see no reason why the dam, as thus reinforced and raised, should not act as one monolithic structure.

THE FASTEST WARSHIP AFLOAT.

The "Tartar," one of the five new 33-knot British destroyers, which had already, in its preliminary trials, broken the world's record for speed by attaining 35.952 knots on an Admiralty course, carried out its final speed trials in December, in the presence of various Admiralty officials. The vessel maintained the unprecedented speed of 35.363 knots throughout a continuous run of six hours' duration, thus covering a total distance of about 212 knots during this period. On six runs over the measured Admiralty knot during the six hours' run the mean speed proved to be 35.672 knots, and the best speed attained on any one run was 37.037 knots, thus creating still another record. This vessel, which was built by Messrs. John I. Thornycroft & Co., is one of the first five high-speed ocean-going destroyers now being completed for the Admiralty, one of which, the "Ghurka," was illustrated in the SCIENTIFIC AMERICAN of January 4.

The turbines of the "Tartar" are of the Parsons type, and steam is supplied by Thornycroft boilers using oil fuel. Of the other boats of this class, the "Cossack" on the six hours' run averaged 33.1 knots; the "Ghurka," 33.91 knots; and the "Mohawk," 35.29 knots. They are of 750 tons displacement and 17,000 contract horse-power. Great interest will attach to the trials of the destroyer "Swift," an 1,800-ton vessel, designed to make 36 knots.

PENNSYLVANIA RAILROAD DELAYS IMPROVEMENTS

The statement recently given out by President James McCrea, that because of the unsatisfactory outlook for raising new capital in 1908, it was necessary and prudent for the company to continue its policy of not beginning any new work and of not committing the company to any capital requirements except those absolutely necessary to economically handle its traffic, has taken effect in several reductions. Although no work will be given up that will in any way affect public convenience, the activity of the railroad will be lessened very greatly in its improvement and construction department. The main projects on which operations will be delayed, or on which work will be decreased, are the New York Connecting Railway to join the New York, New Haven & Hartford with the Long Island Railroad at Long Island City, the terminal at Bay Ridge, and the Greenville yards of the Pennsylvania on the Jersey side. The work on the Sunnyside terminal on the outskirts of Long Island City, as well as the work on the connecting tunnels under Manhattan and on the approaches under the Bergen Hills in New Jersey, will be pushed with all possible energy. On the contrary, the building of cuts and elevated structures to abolish the grade crossings between Flatbush Avenue station, Brooklyn, Long Island City, Jamaica, Manhattan Beach, East New York, and Bay Ridge, will be held up where it has not already been started. The New York Connecting Railway running from Ward's Island Bridge to join with the New Haven twelve miles to the northward, will not be connected. The so-called Glendale cut-off joining the main line of the Long Island from the Montauk Division to Rockaway Beach, will not be begun for the present. The new piers at Newtown Creek and the electrification from Newark to Jersey City will be held up, while the two double-track tunnels through the Bergen Hills, and bridges across the meadows, will be pushed ahead with all rapidity, as was stated above. At the terminal at Eighth Avenue and 32d Street, the work continued will be slightly reduced in volume. Although the twenty-eight acres of buildings and yards were to have been completed in 1909, they will be delayed from six months to a year.

THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The past month has given us several interesting examples of the advantages of astronomical photography in a field which it had only recently entered—namely, the following of faint comets.

The camera is at a great disadvantage, so far as the discovery of comets goes; for it can photograph but a very small part of the sky at once, and it is only by chance that this may happen to include the comet. The visual observer, on the other hand, may in an hour or two "sweep" over a very large region, and he is therefore far more likely to pick it up. But when once a comet has been observed, and its orbit found, we can predict its position at any time, and the great power of photography in revealing faint objects is at our disposal, and this is true even if the comet is moving rapidly, for we can calculate how fast it seems to go and point our instruments accordingly, following the moving object even though we cannot see it.

We can also calculate where the comet was before its discovery, and thus in some cases it has been detected on photographs, made before the comet's existence was known, which happened to include it. The most striking example of the kind is Kopff's comet (discovered in March, 1906, on a photograph taken in Heidelberg), which was subsequently detected on plates taken in 1904 and 1905, and also photographed again last autumn, so that the observations cover an interval of more than three years, during more than half of which the comet's existence was unknown.

In the present month similar photographic observations have been made of Comet 1907 I., which is now retreating from the sun and at a great distance, and also of Encke's comet. The latter, which has the shortest period of any known comet (about 3½ years) has returned to perihelion more than thirty times since its discovery, and its orbit is very accurately known, so that we know just where to look for it at any time. Aided by such calculations, Prof. Wolf, of Heidelberg, has photographed it early in January, while still more than 200 million miles from the earth and nearly as far from the sun. It will rapidly grow brighter as it approaches us, but even at its best in May it will not be a conspicuous object.

Daniel's comet, which was so bright last August, is now visible in the morning sky, and easy to see in a small telescope, and should be observed for some months to come, and perhaps photographed a year hence. There is also reason to hope that Halley's comet, which is due at perihelion in May, 1910, may be photographed this year, when it is between the orbits of Jupiter and Saturn.

THE HEAVENS.

Referring to our map, we find the bright star Capella in Auriga almost overhead. Southeast of it is Taurus with Aldebaran and the Pleiades, and due south is Orion. Southeast of the latter lies Canis Major with the resplendent Sirius, at the west of which are the small groups of Lepus (the Hare) and Columba (the Dove). Eridanus and Cetus occupy the southwestern sky; Aries and Pisces are almost due west, and north of them are Pegasus (just setting), Andromeda above the latter, and Perseus high up near the zenith. Cassiopeia and Cepheus are on the left of the pole, and Ursa Minor and Draco below it, while Ursa Major is well up to the eastward.

The vacant region between the Pole star and Auriga is occupied by the modern constellation Camelopardus (the Giraffe). Gemini, Cancer, and Leo lie in a line sloping down to the right along the eastern sky. The first and last are fine constellations. Cancer contains nothing noteworthy except the star-cluster Praesepe, but at present Jupiter is within its borders and brightens it up very much. The head and neck of Hydra, the great sea-serpent, are visible in the southeast, and almost due south is part of the great southern constellation Argo. Its brightest star, Canopus, which is second only to Sirius, may now be seen, due south and very low down from points in the United States which lie south of Virginia.

THE PLANETS

Mercury is evening star until the 28th of February, when he passes through inferior conjunction, i. e., between us and the sun, and becomes a morning star. He is best visible about the 12th of the month when he is at his greatest elongation, 18 deg. east of the sun. At the time he is easily visible in the evening twilight, just as it grows dark, as it sets about 7 P. M. There is no bright star anywhere near him, so he will be readily identified, especially as he is unusually bright.

Venus is evening star, and is now very conspicuous, setting about 8:30 P. M. in the middle of the month. The most inexperienced onlooker can tell her instantly, since she is twenty times as bright as anything else in the western sky. On the afternoon of the 10th she passes close to Saturn, their least distance being apparently about 1 1/3 degrees. Mars is likewise evening star, setting about 10 P. M. on the 15th. He is rapidly moving eastward, and passes from Pisces into Aries during the month. He is now about 160 million miles distant from us, and his brightness is in marked contrast to what it was last summer.

Jupiter is in Cancer, just past opposition, and is visible all night long. His satellites can be seen with the smallest telescope, and even with a field-glass. The fourth satellite, which is the farthest from the planet (of those visible except in exceedingly large instruments) is west of it upon the 9th and 26th, and east on the 1st and 17th and so on at regular intervals, its period being 16¾ days. The third satellite, which is the brightest of all, may be found east of the planet on the 3d, 10th, 17th, etc., and west of it on the 7th, 14th, etc., its period being a trifle over seven days. The other two satellites move so rapidly that it is hardly worth while to give a similar list for them.

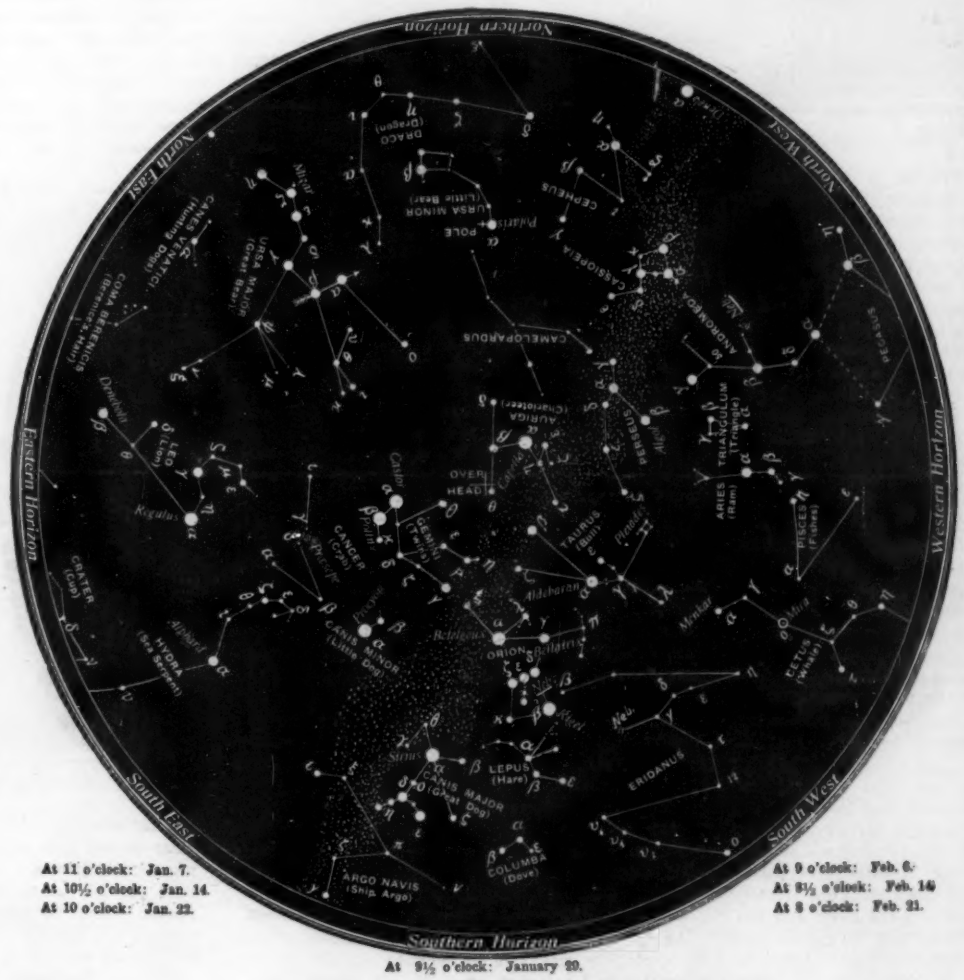
Saturn is evening star in Pisces. His connection with Venus has already been described.

Uranus is in Sagittarius and rises about 4 A. M. toward the end of the month. Neptune is in Gemini, well placed for observation but almost impossible to find without a good star-chart or an equatorial telescope with graduated circles.

THE MOON.

New moon occurs at 3 A. M. on the 2d, first quarter at 11 P. M. on the 8th, full moon at 4 A. M. on the 16th, and last quarter at 10 P. M. on the 24th. The moon is nearest us on the 1st and farthest away on the 14th. She is in conjunction with Mercury on the 3d, Venus and Saturn on the 4th, Mars on the 6th, Neptune on the 13th, Jupiter on the 15th, and Uranus on the 27th. The conjunction with Jupiter is rather close.

Princeton University Observatory.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9½ o'clock: January 29.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

NIGHT SKY: JANUARY AND FEBRUARY

A $25,000 PRIZE FOR A MATHEMATICAL SOLUTION.

In 1665 there died in Toulouse a French lawyer, Pierre de Fermat, who made a hobby of mathematics, and enriched the treasures of that science by several most interesting formulas. Unfortunately, he had the habit of announcing his discoveries without any mention of the means by which he arrived thereat, or affording any special proof or method of proof. He simply inscribed them in the margin of his favorite copy of the *Arithmetica* of Diaphantos of Alexandria. When in 1670 his son issued a new edition of Diaphantos, he printed his father's marginal notes along therewith. As almost every one of these notes was new, and had for pure mathematics some meaning and value, they have afforded for many years material for much study, discussion, and proof. It was a long while before their demonstration was in any way complete; and there remains to this day one which is known to mathematicians simply as "the" Fermat formula or rule, and which has not yet been proved mathematically. This formula or rule is to the effect that while the sum of two squares of whole numbers may (not must) amount to the square of another whole number—as for instance $6^2 + 8^2 = 36 + 64 = 100 = 10^2$—the sum of two cubes can never be the cube of a whole number; the sum of the fourth powers of two numbers can never be the fourth power of a whole number, etc.

To prove a negative is, as a rule, more difficult than to demonstrate a positive; in fact, in law the burden of proof rests always on the one asserting the positive side of the question. Here the fact remains; Fermat's assertion that the sums of higher powers than squares can never amount to a corresponding higher power of a whole number appears to be invariable, but no mathematical demonstration thereof has as yet been offered.

In order to stimulate mathematical discussion and demonstration, Dr. Paul Wolfskehl, who died not long ago in Darmstadt, left in his will a provision for the payment of 100,000 marks ($25,000) to the first person who would afford the mathematical proof of "the" Fermat formula for all quantities. The Göttinger Gesellschaft der Wissenschaften has the consideration of solutions offered and the awarding of the prize to the successful applicant. Such celebrated mathematicians as Euler, Dirichlet, and Kummer have given proofs which cover a number of special cases, but no one has as yet shown that the rule is absolute for all whole numbers.

A STRIP OF TERRITORY ADDED TO ALASKA.

It is reported in Ottawa that a strip of territory a furlong wide and some fifty miles long, will be added to Alaska, owing to the work that has just been completed positively locating the 141st meridian. There was no dispute as to the location of the boundary to the north of Mount St. Elias, since it was agreed a number of years ago that the line should follow the 141st meridian from that mountain northward to the Arctic Ocean. The line, however, had never been actually marked. Of late years the extensive mining operations in the White River country have led many prospectors to stake out claims which may or may not be in the United States territory. By means of the telegraph, the most accurate method known, the old determination made by the lunar method was checked up, placing the meridian about 600 feet farther east than it had hitherto been supposed to exist.

A UNIVERSAL BENCH VISE.

In the accompanying illustration is shown a handy and convenient bench vise which has been devised by an English inventor. Every bench worker is fully aware of the trouble and difficulty encountered with the general tool of this type when engaged upon an

UNIVERSAL BENCH VISE, SHOWING BALL AND SOCKET ACTION.

intricate piece of work, and how the latter has to be readjusted in order to bring the most awkward points in a position most advantageous for working. By this continual loosening and reclamping of the work, much delay is caused. With the universal vise, however, once the work has been clamped up in the jaws of the tool, there is no necessity to release it again until the task has been completed. To the bench is screwed a heavy socket, while the pedestal of the vise terminates in a ball working in this socket. In this manner the vise can be swung through any angle and turned completely around as desired, thereby always rendering it possible for the work to be placed in the most favorable position for operation. The ball and socket motion is controlled by a single bolt shown at the side of the table fixture, while by the slackening back of two nuts the socket can be opened to permit of the entire withdrawal of the vise. In a later modification of this tool, which has secured a wide appreciation among engineers, the jaws themselves work upon the ball and socket principle, so that a double universal action is obtained, allowing the work to be twisted and set in any desired position.

A MOTOR CHAIR INVENTED BY A WOMAN.

The accompanying illustration shows an interesting and ingenious vehicle invented by Miss Ida M. Schmidt.

An invalid from an early age, Miss Schmidt has realized the limitations of the ordinary invalid chair. Owing to its weight, it is impossible for an attendant to push it for any distance. When the automobile first became a commercial fact, the inventor designed a two-piece vehicle—the invalid chair and the tractor. By turning a simple thumb screw, the chair and the tractor were connected or detached. This proved satisfactory for street or park use, but it was found to be too long for turning in a narrow space. To overcome this difficulty, Miss Schmidt produced her present motor chair. It is an electric cab, complete, carrying a storage battery, and under perfect control.

THE SCHMIDT MOTOR CHAIR.

It may be safely maneuvered on the most crowded walk.

The chair is 42 inches wide, carries a 1¼-horsepower motor, and has a capacity of about ten miles over ordinary city pavements. It promises to be a useful help, not only to invalids, but to many elderly persons who cannot afford an automobile and who do not crave speed.

A New Type of Fare Register to be Used on the New York Pay-as-You-Enter Cars.

The pay-as-you-enter cars which it is proposed to install on the New York city lines will be equipped with a device for collecting and automatically registering fares. The chief advantage in this apparatus is that the conductor does not have access to the money until after it has been registered; immediately upon its registration, however, he can take all that he needs for the purpose of making change. The fare is dropped into a slot at the top of the box, and is immediately registered and exposed to the conductor's view, enabling him to detect bad coins and to see by whom they are put in. The last three or four nickels inserted in the machine remain in sight, giving the conductor some slight leeway in the matter of time. After being exposed to inspection, the coins are pushed one at a time into a top drawer, to which the conductor has access.

The operating mechanism of the machine is very simple. After the coin has been dropped into the slot, it falls to the bottom of a tube, where it bridges a break in an electric circuit. When this circuit is closed, a lever is operated which pulls the registering mechanism and allows the coin to slide into view. So simple is the mechanism, that the one part that might require renewal even after extended use is the battery of dry cells furnishing the operative power. These are placed beneath the cash box in a drawer. In a test, 175,000 registrations were made without either exhausting the battery or appreciably wearing out the parts that registered the number of coins. Should the registering apparatus get out of order, the usefulness of the apparatus, although impaired, is by no means destroyed. Under such conditions, the money dropped in the slot falls down a side chute into a locked receptacle, to which the inspector alone has access. Registration can still be carried on by the conductor, for when the cash drawer is opened, a rod is disclosed that operates the register when pulled. Since only the conductor has the key to the change drawer, fares cannot be rung up by anyone else.

Lake Tahoe Sinking.

According to recent reports, Lake Tahoe in the Sierras is falling rapidly. The lake is situated on the boundary of Nevada and California near Reno, Nev. About a month ago it was observed that the waters were receding. In four weeks' time they had dropped fully six feet. The cause of the subsidence is a mystery. Two years ago the waters rose rapidly to such a height that the surrounding towns were seriously threatened. The lake is very deep, and is situated in what some believe to be an extinct volcano. Possibly the mysterious changes of level may be due to volcanic action. According to a legend of the Washoe Indians, the waters once were hurled out of the lake by some subterranean force, and overwhelmed the inhabitants of towns in the valley to the east.

Destruction of Rats by Means of Electric Current.

An interesting device for the destruction of rats, mice, etc., by means of an electric current has been suggested and patented by A. F. von Biederheim. It consists of several rows of metal points arranged a short distance apart beside each other, connected partly to the positive and partly to the negative terminals of an electric high-tension circuit. The animal, on coming into contact with these points, is killed by the electric shock; the point effect at the contact with the animal causing the electric current to enter the interior of the body. Between the several rows of points there is placed a bait to attract the animals to be caught. The points are arranged inside of a vessel provided with an elevated edge, so that the victims, after being electrocuted and thrown aside, remain in the vessel. The apparatus is designed to be readily lowered into drain pipes, etc., in order afterward to be removed along with the killed animals. According to reports in the Austrian press, experiments have been made on this apparatus at the electric factory of Signor Galatti at Trieste with exceedingly satisfactory results. It is said that the apparatus is so designed as to kill only rats and similar vermin, while in no way endangering domesticated animals.

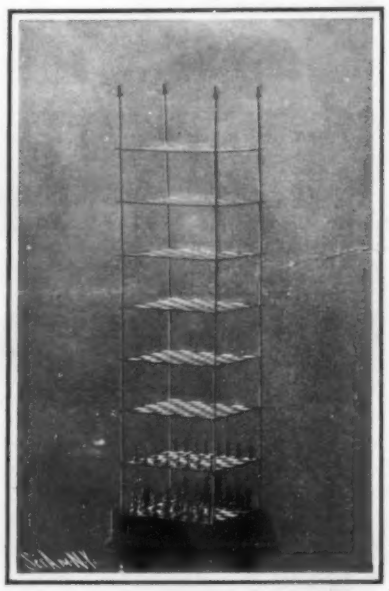
Work is progressing on the Katanga Railroad, all but a few miles of which will be in Portuguese West Africa, extending westward from the Atlantic at Lobito Bay, near Benguela, about 800 miles to Katanga, in the southeastern part of the Congo State, around which are very valuable mines. Fifty miles along the coast are in operation, and work is progressing on 200 more with a force of 8,000 men, 1,500 of whom are Hindoos brought from Natal.

CHESS IN THREE DIMENSIONS.

BY OUR BERLIN CORRESPONDENT.

An interesting improvement on the classical chessboard, namely, an extension of the game to a third dimension, has been suggested by a Hamburg physician, Dr. Ferdinand Maack. The model presented by the inventor at the recent International Chess Tournament held at Karlsbad is illustrated herewith. It comprises eight superposed chessboards. The new tridimensional game bears the same relation to the familiar board chess as a cube does to a square. In fact, while the bidimensional chessboard is made up of $8^2 = 64$ squares, the tridimensional game is played with a system of $8^3 = 512$ small parallelopipedons.

Now, each parallelopipedon has three mathematical properties, namely, surfaces, edges, and apices, or angles, from which the moves of the various pieces are derived. The castle moves normally to the planes or parallel to the edges, the bishop moves through the edges or parallel to the diagonals of planes, and the knight moves through apices, parallel to the general diagonal of the element. All three of these pieces can move until stopped by the limits of the compound board, or by another piece. (It will be observed that the moves of the castle and bishop are simply extended to three dimensions, while the knight's move is radically different from the knight's move in ordinary chess.) The queen enjoys the combined privileges of castle, bishop, and knight, the king's move is like the queen's but is limited to a single step, and the pawns move one step castle-wise and take diagonally or bishop-wise (but not knight-wise).



CHESS IN THREE DIMENSIONS.

Tridimensional or cubic chess is played with the same typical men as board chess, but with a greater number of pawns. The number of pawns actually used depends on the operation basis adopted. If the lowest board be chosen as basis, a set of "front pawns" and a set of "upper pawns" will be required, the former serving as protection against attacks from above and the latter against attacks from the front. If, on the other hand, any one of the intermediary boards be chosen as basis of operation, eight "lower pawns" will have to be added below the higher men to protect against attacks from underneath.

It is claimed that so far from being an artificial complication of the game, cubic chess is a natural, logical, and mathematical complement to the board chess. As chess is the play of motion *par excellence*, and as motion takes place in space, the natural evolution of the game calls for a third dimension. On the other hand, chess may be said to be even more than a game, being the exemplification of an ancient geometrical science which could not emancipate itself from the two dimensions of the plane. According to a hypothesis suggested by Dr. Maack, the tridimensional game would even be the *primitive chess*, from which board chess would be only a derivation, viz., a projection on the lowermost plane.

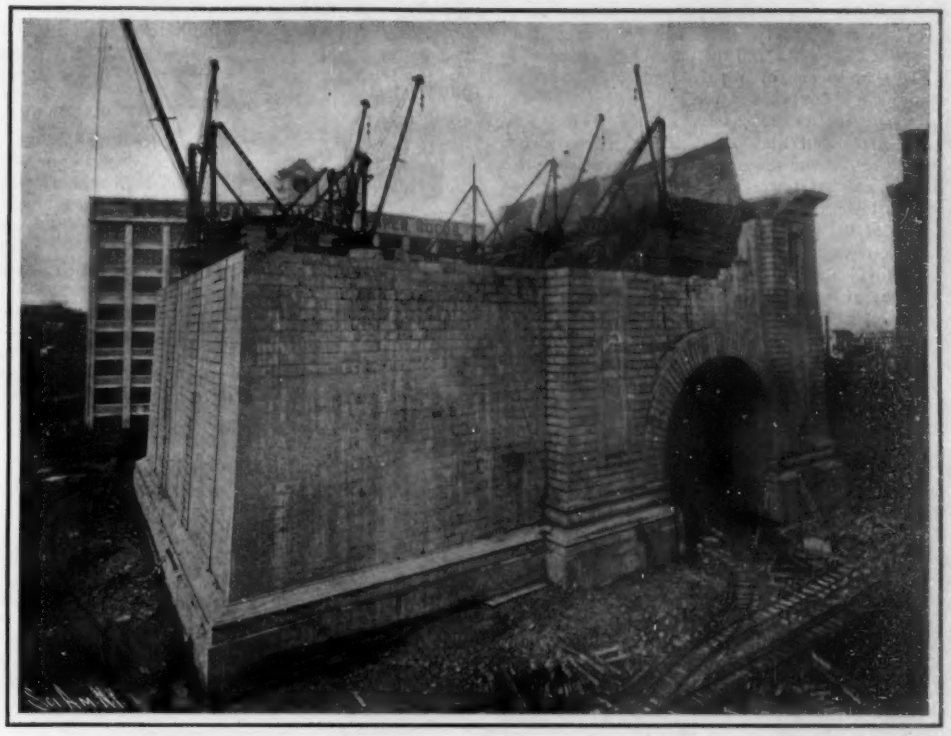
Another point to be considered in this connection is the well-known analogy of chess with war. In the same way as modern strategy has been extended to a third dimension by adopting airships and submarines, thus utilizing the whole of space, chess in order to remain a strategical game should avail itself of the whole of space, that is, of all three dimensions.

It will be readily understood that this ingenious extension of the game of chess lends itself to an unexpected variety of new problems likely to appeal to the minds of chess players.

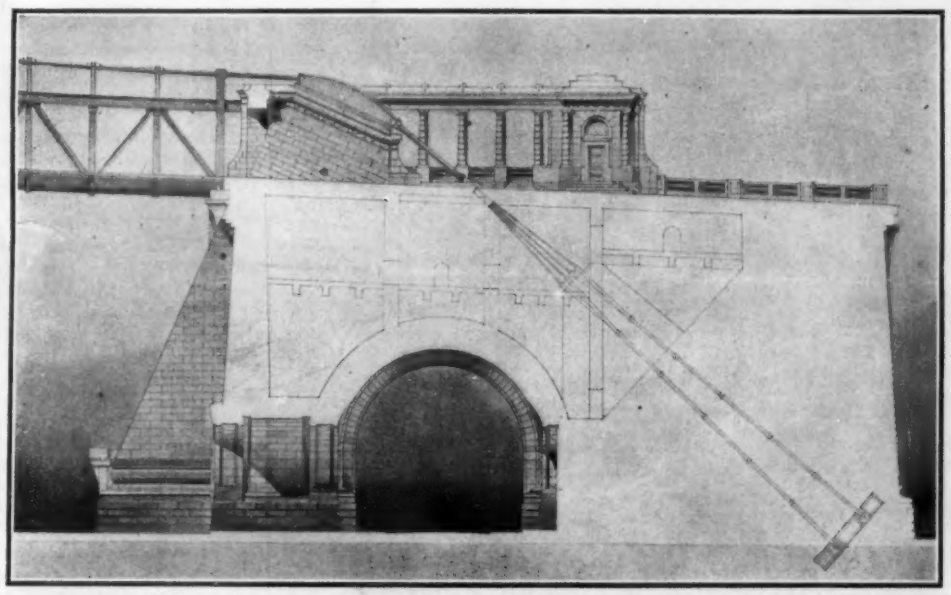
ERECTION OF THE MANHATTAN BRIDGE ACROSS THE EAST RIVER.

Now that the erection of the steel work of the long-delayed Manhattan Bridge over the East River has actually begun, it is gratifying to note that it is being pushed forward with a degree of celerity which gives reason to hope for an early completion of this much-needed structure. The Brooklyn anchorage is completed, and the anchor chains are in place. The Manhattan anchorage is practically completed. The erection of the two towers of the main span is about one-half done, and, at the present rate of erection, they should be carried to their full height in about two months' time. The fixed saddles, which will be bolted to the top of the towers and serve to carry the main cables, will be 322½ feet above mean high water of the East River, and, as soon as these have been put in place, everything will be ready for the stringing of the main cables—a work which the contractors expect to carry through with far greater celerity than marked the stringing of the cables of the old Brooklyn or the Williamsburg Bridge. Because of the new methods which they intend to employ, they expect to have the cables completed within twelve months of the stringing of the first wire. With the cables finished, say by the late spring of 1909, the bridge should be ready for opening by the summer of 1911.

The Manhattan Bridge will be not only the heaviest suspension bridge in existence, but, for its length, it will be the heaviest bridge of any kind yet built. Although its span will be 140 feet less than the span of the big cantilevers of the Forth Bridge, the enormous load which the bridge is designed to carry will call for a weight of cables and suspended superstructure, which will easily make this the heaviest and strongest bridge in the world. The Forth Bridge carries only two steam railway tracks; and, although that bridge is such a splendid piece of work as regards strength and rigidity that the fastest Scotch express trains run across it at full speeds of 60 miles an hour and over, the live load is exceedingly small compared with the size and mass of the cantilever. The Manhattan Bridge, on the other hand, will have to carry no less than eight railroad tracks, in addition to a wide roadway for vehicles and two footpaths for pedestrians. The suspension bridge proper, disregarding the approaches, will consist of a main span 1,470 feet long, and two side spans each 725 feet in length. The total width of the floor of the bridge will be 120 feet, as compared with the width of 85 feet of the old Brooklyn Bridge.



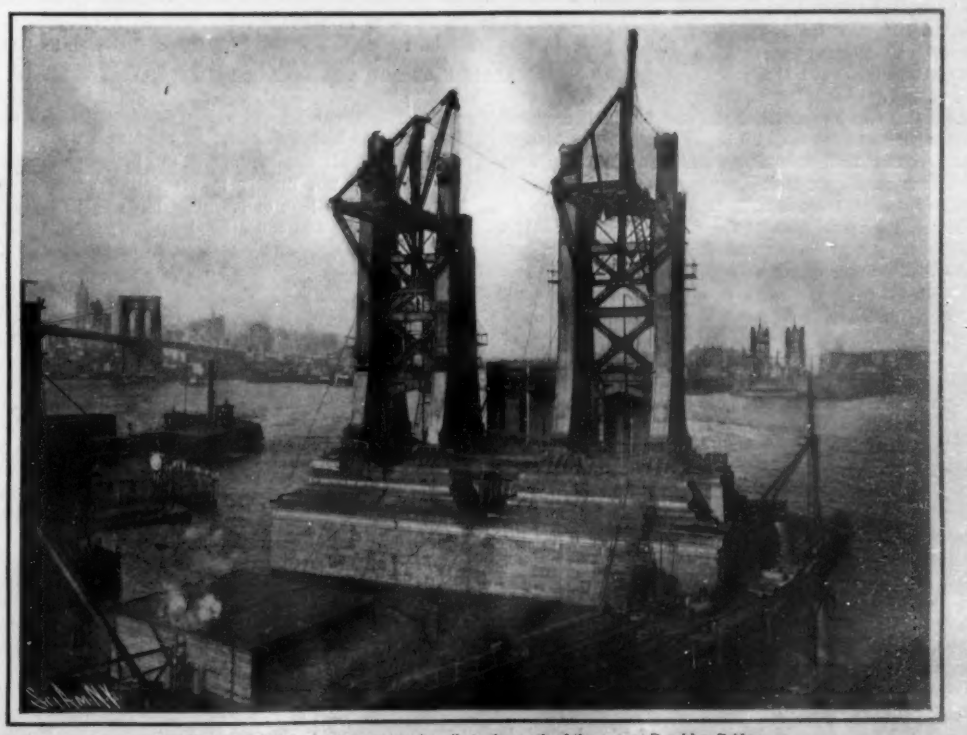
Brooklyn Anchorage. The Arch, 46 Feet Wide, is Built to Provide Uninterrupted Street Thoroughfare.



Longitudinal Section of an Anchorage, Showing Attachment of Cable to Anchorage Bars.

The total pull of the four cables amounts to 30,000 tons, and to resist this it is necessary to provide exceptionally heavy anchorages. Each anchorage covers an area 237 feet by 181 feet 10 inches. Their height above ground is 135 feet; and each contains 115,000 cubic feet of masonry and weighs 233,000 tons. The anchorages are built on a foundation of piles, which are driven as closely together as they will go under the top or forward end of the anchorage, where the pressure is greatest, the spacing of the piles widening out toward the rear, where the pressure is least. The anchorages are built of cyclopean rubble and concrete, with a facing of granite. The anchor bars are imbedded in the body of the masonry and anchored to a massive set of anchor girders, as shown in the accompanying sectional view of one of the anchorages. There are nine of these anchor girders to each cable. Eight of them carry four strands of the cable, and the ninth five strands, there being altogether thirty-seven strands in each cable. The eyebars are 110 feet long; and the magnitude of this work will be understood, when it is stated that there are altogether six miles of eyebars in each anchorage.

The foundations for the main towers extend down 92 feet below mean high-water level. Each foundation covers an area 78 feet wide measured in the direction of the length of the bridge, and 144 feet measured transversely to the bridge. The caissons are 56 feet in height, and above them the solid masonry of the piers is carried up for a further height of 67 feet, making a total height from foundation to capstone of the piers of 123 feet. The granite surface of the top of the piers is very carefully leveled off, and upon it is laid a wrought-steel pedestal, measuring 18 feet by 43 feet, the foundation plate of which is 2 inches in thickness. The pedestal has a total depth of 5½ feet. It is heavily ribbed, and constitutes one of the most massive and difficult pieces of built-up riveted steel work of its kind ever constructed. Upon this pedestal rests the steel tower, which consists essentially of four huge box-section legs heavily braced together, each leg having a uniform width transversely to the axis of the bridge of 5 feet, with a length parallel to the axis of the bridge varying from 32 feet at the base to 10 feet at the top of the towers. The legs are also stiffened against lateral deformation by two intersecting plate-steel diaphragms of a general I section, which are 7½ feet in depth and spaced 2½ feet each side of the vertical axis of the



The new bridge is about a quarter of a mile to the north of the present Brooklyn Bridge.

View from Brooklyn Side, Showing Brooklyn and Manhattan Towers and Old Brooklyn Bridge to the Left.

ERECTION OF THE MANHATTAN BRIDGE ACROSS THE EAST RIVER.

tower legs. Our front-page illustration shows one of these towers at a time when it had been carried up about two-fifths of its full height. The erection is being done by means of a pair of massive derricks, which are carried upon the tower itself, and hoisted to a new position as soon as the steel work has been built up to the full limit of their hoisting capacity. The steel work of the towers is riveted up in complete sections at the steel works, and is delivered at the foot of the towers on barges, from which it is hoisted to the top of the piers, to be finally lifted in position by the erecting derricks.

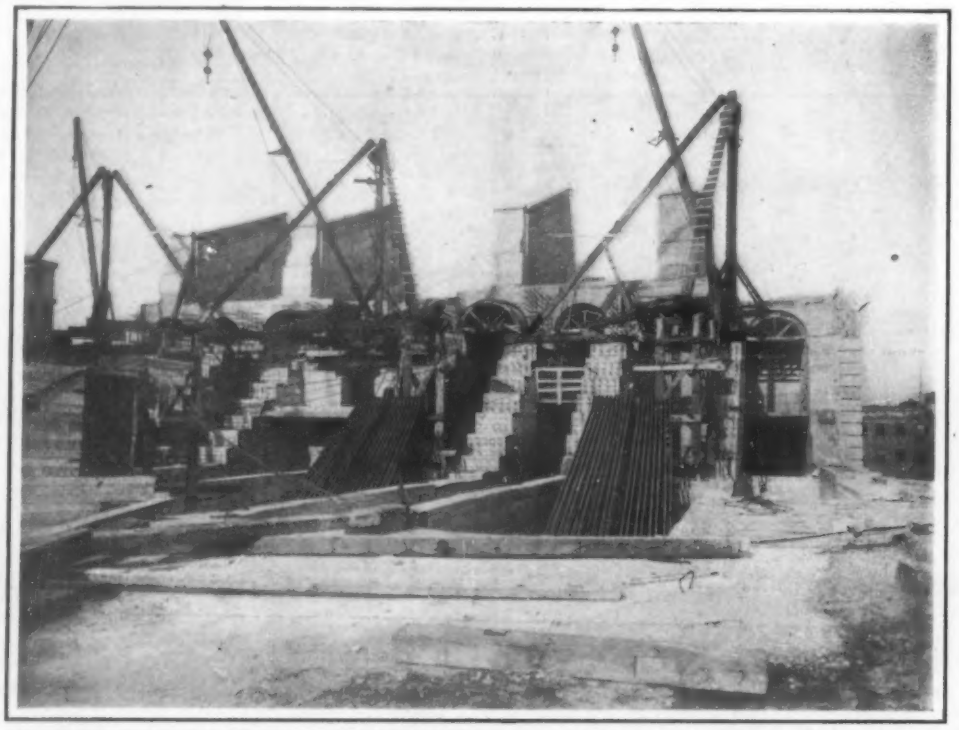
The original design by the former Commissioner, Mr. Lindenthal, was for an eyebar suspension bridge, the towers of which were to be carried on huge 24-inch pins providing for movement of the towers in the longitudinal plane of the bridge—an excellent arrangement, conducing to great accuracy to the determination of stresses, both in the towers and on the masonry. When the present plans were substituted, it was decided to dispense with the pins and use the flat footings as described above. At the same time, since the cables were to be rigidly attached to the tops of the towers, it was necessary to make the towers very much heavier, to enable them to withstand the bending stresses which would result from the variations of the loading of the bridge. These bending stresses, under normal or working load, will cause a movement toward the center of the main span of from 6 to 9 inches, and under maximum congested load of 2 feet 1 inch. This means that in addition to the vertical compressive load, due to the weight of the structure, there will be additional loads due to the bending over of the towers toward the center of the span. Hence these towers are necessarily very heavy, the total weight of steel in each one being 6,500 tons, or from 1,500 to 1,700 tons more than would have been necessary had the towers been free to move on pins at their base. The total load on each tower is 32,000 tons under the maximum possible congestion of traffic on the bridge. The area of the metal in the towers at the top is 4,400 square inches, and at the base 14,800 square inches. The maximum possible unit pressure on the steel of the towers at the base, under congestive load, is 27,500 pounds per square inch, this including both the vertical loads and the stresses due to the bending of the towers. The maximum unit stress under the reasonable ordinary working load will be 20,000 pounds per square inch. It should be explained here that the maximum congested load with four tracks crowded from end to end, the roadway a continuous jam of vehicles, and the footpath crowded with people, is 8 tons per linear foot of the bridge, and the maximum assumed working or ordinary load is 4 tons per linear foot.

The main cables are 21¼ inches in diameter measured on the wires without the wrapping or sheathing. Each of the four cables contains 9,472 wires, 3/16 of an inch in diameter, all of which are galvanized. The total length of single wire in all the four cables will be 23,100 miles, or nearly sufficient to girdle the entire earth. The wire will have an ultimate strength of 215,000 pounds to the square inch, and the main cables will be subjected to a working load of 60,000 pounds, and a congestive load of 73,000 pounds to the square inch.

The suspended roadway will consist of four trusses, carried in the planes of the legs of the towers, each truss being 24 feet deep center to center of chords. Each pair of trusses will measure 28 feet from center to center, with a spacing of 40 feet between the inside trusses. The four railroad tracks will be carried, two of them on the lower, and two of them on the upper, deck of the trusses. The two footways, each 10 feet wide, will be carried on the outside of the outer trusses, on cantilever extensions of the floor beams. The central roadway for vehicles, 35 feet wide, will occupy the center of the bridge on the level of the lower deck of the trusses.

A novel feature will be the use of nickel steel in the upper and lower truss chords, which will be subjected to a working stress of 40,000 pounds to the square inch. The nickel-steel rivets will be subject to a working stress of 20,000 pounds to the square inch. In spite of the higher cost of the nickel steel, the saving in weight will be such as to make the trusses actually cheaper than if they were built entirely of ordinary structural steel. The weight of steel in the superstructure from anchorage to anchorage, exclusive of the cables, is 10,500 tons of carbon steel and 8,000 tons of nickel steel. The weight of the cables is 6,300 tons, and the total weight of steel in the whole bridge, including anchor chains, cables, towers, and suspended span, is 42,000 tons.

The Bridge Department is to be congratulated on the fact that, in spite of the great weight and carrying capacity of the bridge, it will, in its completed form, be characterized by much of that delicacy and grace of appearance which has made the Brooklyn Bridge so justly famous, and the absence of which renders the Williamsburg Bridge one of the ugliest structures of its kind ever erected.



Top of Anchorage, Showing Eyebars to Which Cables Will be Attached. Each Anchorage is 135 Feet by 237 Feet on the Base; 135 Feet High; and weighs 232,000 Tons.

ERECTION OF THE MANHATTAN BRIDGE ACROSS THE EAST RIVER.

The Death of Morris K. Jesup.

In the death of Morris K. Jesup, who passed away on Wednesday, January 22, we have lost not only a gentleman who was distinguished for his active philanthropy and for his achievements as a banker and a public-spirited citizen, but as an ardent supporter of science. With the exception of John D. Rockefeller, Peter Cooper, and Andrew Carnegie, it may safely be said that no American has ever spent money so liberally in adding to the sum total of human knowledge. Passing over Mr. Jesup's mercantile career to those scientific and educational endowments which should more properly be discussed in these columns, it should be noted that his benefactions in the interest of education consisted not merely in presenting buildings to American institutions of learning, but also in furthering the literary and educational features of university life. Perhaps Mr. Jesup's interest in science found its fullest expression in the noble aid which he gave to the American Museum of Natural History during his long term of service as its president. Under his ceaseless care the institution was so far enlarged, that it has assumed a commanding position among the museums of the world. At a cost of one hundred thousand dollars, he commissioned Prof. Charles S. Sargent to prepare a collection of woods in the United States, comprising more than 400 species of native trees, representing the forest wealth of the country. Hardly a scientific expedition was sent out by the museum that was not equipped with his aid. Indeed, the wonderful anthropological collections of the museum owe their existence almost entirely to him. Much of this anthropological material is the outcome of a scheme to explore the coast of the north Pacific Ocean, for the purpose of establishing the ethnological relations between America and Asia. Commander Peary, too, profited by Mr. Jesup's bounty; for not only did Mr. Jesup fit out one of the relief expeditions which brought Peary back from the Arctic, but he later became a generous supporter of Polar exploration. Fittingly enough, Commander Peary named the most northern point of land that he discovered Cape Morris K. Jesup.

Coal Dust as a Cause of Mine Explosions.

BY DAY ALLEN WILLEY.

While many of the mining accidents in the United States have been due to the ignition of the gas commonly known as fire damp—the hydrocarbon gas which is scientifically termed methane—the recent disaster in West Virginia, and possibly the ones in Pennsylvania, may be due to an entirely different cause, and their investigation may result in disclosures that mine dangers are far more numerous than has generally been supposed.

The mines which were the scene of the accident in West Virginia are not considered gaseous to a dangerous extent, for the reason that they were unusually well ventilated, the system of fans employed being one of the most modern in the country. The evidence shows that they were always carefully inspected before the miners began operations, and that apparently every precaution was taken to guard against fire or explosion. A brief outline of the disaster at Mononga is necessary to understand the conditions which probably caused it. Mining experts who have visited the workings and have obtained the evidence of reliable eye witnesses, agree that the first explosion occurred immediately after a portion of a train of loaded cars became separated from the balance of the train on an incline, and rushed back into the mine. When they were found, beside them was an electric trolley wire used for operating the tramway. This wire, which ordinarily carried a current of 280 volts, was torn from its fastenings by the derailing of the cars at the bottom of the slope. All of the testimony is to the effect that the explosion "gathered force"—being really a series of explosions quickly following each other in the mines. The first explosion apparently was in the vicinity of the wrecked coal cars. The conclusions of several of the experts are that the disaster was actually due to the ignition of coal dust from a flame thrown out by the electric current of the trolley wire when it was torn from its fastenings and the circuit obstructed.

If this is true, coal dust is another mine danger which must be more seriously regarded in the United States—a danger which can well be considered of great magnitude, since this detritus is present in such large quantities in many workings where the percentage of moisture is so small that it is literally in dust form. The statement is made that the accident in West Virginia has come as a complete surprise to mine owners and engineers, because never before has a casualty caused such widespread damage in the interior of a mine, to say nothing of the enormous loss of life, when apparently no reason existed for it. Yet the explosive and inflammable properties of not only coal dust, but other fine substances, are not unfamiliar, and have been time and again shown by experiments, while a number of flour mills have been destroyed by fire originating in the flour which they were grinding.

Not only engineers from various parts of the United States, but several French and English colliery experts, have visited the West Virginia and Pennsylvania mines to investigate the accident, on account of their apparently mysterious origin. The Monongah disaster, however, has parallels in what are known as the Camerton and Timsbury accidents, which afford strong proof of the coal-dust theory. Fortunately, the Camerton affair was made the subject of such exhaustive and rigid investigation, both by the colliery owners and the British government, that its results are of much value in studying the one in West Virginia. The Camerton, which is located in Somersetshire, has the reputation of being a non-gaseous mine like the Monongah. Methane was unknown in it. Prior to the explosion, it had been worked for a number of years with no accidents of any extent. Two miners were sent to blast away the roof of one of the galleries to enlarge it for tram cars. They descended into a shaft in the evening, and four hours later a series of explosions occurred, although they were the only miners in the workings. After the disaster all of the galleries and chambers were thoroughly examined, the effects of heat and concussion upon the timbering

noted, and the condition of the atmosphere tested. Among the experts called to the scene was Mr. Donald Stuart, the eminent mining engineer, who agreed with his associates in the conclusion that the accident was due entirely to the ignition of coal dust by one of the charges of explosives.

The effects of the ignited dust were plainly visible in a distance of no less than one mile of the workings. Four hundred feet away from the spot where the first explosion occurred, a twelve-inch wrought-iron pipe was found bent and broken as if a dynamite cartridge had been laid upon it and exploded. Timbers nearly five hundred feet away were twisted and shattered. Large wheels assisting to move mine cables were wrenched from their fastenings and broken. A thousand feet away from where the bodies of the miners were found, heavy timber props were displaced, and the roof of the mine passage dislodged, so that the latter was nearly filled up. In short, all of the evidence went to show that the explosion caused directly by the blasting charge was merely one of ten, where bodies of coal dust had been successively ignited by the high temperature, and that in most cases the explosive force was far more violent than at the original point.

The investigation at Camerton was so exhaustive and minute that every portion of the mine affected by the explosion was examined, the residue left after the coal dust had been ignited was analyzed, and tests also made of the effect of blasting powder such as used in this mine and upon coal dust under various conditions. The examination of the passage in the vicinity of where the explosive charge had been fired, showed that the dust had been exposed to a very high temperature. The sides of the passage were partially covered with a fine coke or cinder—the material into which the dust had been converted by the action of the heat. Broken ends of props and other wood were found crusted with this coke. After setting fire to the fuse, the miners had retired to a refuge hole about one hundred feet distant. Their bodies were found in the passage one hundred and fifty feet away from the blast, however. The portions of the bodies not clothed showed that they had met their death by burning. Evidently they had sought to escape from the fire, which had been caused by the effect of the blast or possibly the ignition of the fuse, but the dust in the passageways had burst into flames so rapidly that they could not escape. All of the data obtained by the experts went to show that the heated products of the blast powder disengaged the gases in the coal dust, producing a gaseous body of such high temperature that it quickly ignited the coal dust about it. Such was the volume of heat produced that there were places in the passage where the fire, if it may be called such, literally leaped over spaces two hundred feet in length where the coal dust was too damp to ignite. These gaps caused the series of explosions so quickly following each other, and it is probable that the same conditions will be found upon investigation to have existed in the West Virginia mine.

The quantity and arrangement of the dust in the Camerton colliery is one of the most important factors in considering the disaster. The layers of dust of course varied in thickness. While at some points as much as five inches covered the floor, the many experiments made demonstrated beyond question that if the dust were sufficiently dry, a layer so thin that only one pound covered sixteen square feet of surface, would be completely incinerated when the particles on the edge of the area were exposed to a temperature sufficient to ignite them. In one test a pile weighing one and one-half ounces was spread as evenly as possible over a square foot of mine bottom. It was so inflammable that apparently every particle burned, the flames ascending to a maximum height of about two inches. Where the dust was several inches thick, the height of the flame tongues was increased in proportion, thus explaining how in many parts of the workings they had reached to the roof, and ignited the dust there accumulated.

In the Monongah mines it is admitted that the coal dust lay several inches deep on the bottom of the tramway where the first explosion occurred. When the coal cars re-entered the mine, those who saw them disappear in the mine entry, say they were nearly concealed by the dust which rose in the air. It is fair to assume that the rapid motion of the cars kept this dust cloud in motion until the flame from the electric current came in contact with it. If the same conditions prevailed as in the Camerton mine when the fatal blast was discharged, the flame acted on the dust somewhat as it might have acted on a lot of gunpowder spread loosely about. The investigation of the Camerton disaster showed that the dust had become a highly inflammable powder actually dried by the air currents for ventilation, so that merely a few sparks were needed to ignite it. If the investigations in West Virginia and Pennsylvania show that the dust was in the same condition, we probably have the mystery surrounding these disasters completely unveiled.

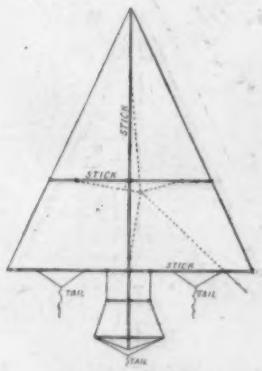
Should this theory be true, it indicates that a mine may be dangerous on account of too much dampness and too little ventilation, while on the other hand it may be dangerous by reason of too much dryness, possibly caused by too great ventilation. Fire damp, as we know, accumulates in large bodies where the air current is not sufficiently strong to expel it from the chambers and passages, but on the other hand there is the possibility of having a mine too dry, so to speak, especially if large quantities of dust accumulate within it; for if this material is not removed or dampened by some effective method, it is a continual menace, which is perhaps more deadly than even the fire damp itself. When ignited the flame spreads through the entire mass with such rapidity, that it may cause great destruction in such a short period that it is impossible to prevent it from literally wrecking the mine, as was the case in Monongah.

Correspondence.

New Forms of Kites.

To the Editor of the SCIENTIFIC AMERICAN:

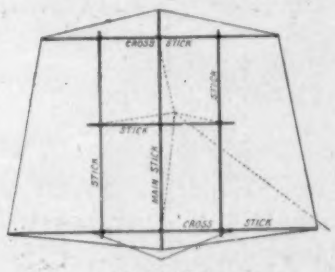
In your issue of August 10, 1907, you give a very interesting account of the kite-flying observations, in which I am greatly interested. The article does not cover a very extended field so far as I can read, either in variety or result, but still is of much interest and



ARROW KITE.

value. I observe that the box kite is about the only one so far recorded. I had looked for a large variety in pattern, as also in extent of flight.

I have always been a great patron in her majesty's domain of Kiteland, and I may say somewhat of an originator, as you will see by the inclosed diagrams of the first "sailor kite." I find it the most perfect flyer as well as stayer among all kites. I was the maker and flyer of this kite in the original trial. Have made hundreds of kites, though not all shapes,



SAILOR KITE.

and shaped this one to meet the fickleness of California winds. Its extreme lightness and elasticity will not withstand strong gusty winds, but for light zephyrs it is a superb flyer. In my experience it is the finest kite in shape and action of any kind (excepting perhaps the box variety, about which I know very little) I have ever handled. But it is not one easily handled by boys who have little experience in kite flying, as it requires skill and knowledge to guide it.

The arrow kite is something new, and will prove a valued addition to kitedom, as it carries three tails, and will prove a high flyer. Both these kites will require care, both in the making and material.

Azusa, Cal. NORMAN J. OSBORNE.

Measurement of the Historic Arc of Peru.

BY J. W. DAVISON.

The committee of the French Academy of Sciences in control of geodetic operations on the equator announces the completion of the measurements of the historic arc of Peru, a great scientific work, perhaps the most important completed thus far in the twentieth century. The announcement of the French Academy is of special interest to American geodesy inasmuch as two of America's most eminent geodesists have taken the initiatory in the work.

In 1889, Prof. George Davidson, of California, suggested that the French nation had the prior right in this remeasurement of the arc, to reconcile an unsettled question whether the equatorial or polar axis was the longer. The relative length of the axis in the geodetic science of the present time had become so important that Assistant E. D. Preston, of the United States Coast and Geodetic Survey, at the International Association, at Stuttgart (1898), renewed the discussion of this question, and it was voted that the French nation begin the remeasurement of the arc.

This arc is known as a part of an astronomical circle traversed by the sun or a star between its rising and setting, and was first measured by the French savants to decide a question in regard to the form of the earth which had arisen over the result of Cassini's surveys in France. This work is a costly and gigantic task, and when it was first accomplished the feat gave additional luster to the scientific fame of France, and when the result was made known the scientific world accepted Newton's theory of our globe being an oblate spheroid. The first measurement early in the eighteenth century covered a period of nine years, in the triangulation and base measurements, the second not quite so long—1899 to 1907.

It seems this question as to the length of the polar and equatorial axis arose in this way: A clock having been carried from Paris to the equator was found to lose two minutes each day. This fact was supposed to strengthen Newton's theory that the earth is an oblate spheroid; therefore, to reconcile these two dimensions, the French Academy first undertook the measurements of meridianal arcs, one on a frozen river in Lapland, the other above the clouds in Peru.

Strictly speaking, this arc is not in Peru, according to the geography of to-day, but in Ecuador, extending from Tulcan to Payta, embracing 74 geodetic stations, three base-line measurements, six azimuth determinations, 64 determinations of latitude, 48 magnetic stations, distributed all along the arc, six pendulum stations. Eight differences of longitude determined between stations at Tulcan and Payta and the comparison of the differences of longitude, geodetic and astronomic, between the two will throw light on the form of the geoid, as the first two stations are on the coast and the third in the Andes above the clouds.

This great work, which was begun by the officers of the Geographic Service of the French army, leaving Paris for Ecuador in May, 1899, was continued until completed, and embraced also a study of the natural history and important collections in botany, zoology, anthropology, and ethnology of the most interesting section of our globe. The preliminary computations of the work are so far advanced as to assure the value of the observations, and the publications of the results are regarded as an important event by geodesists and scientists throughout the world.

The Current Supplement.

The Automobile Club of America has installed a most elaborate testing plant for automobiles in its new club house. This plant is very fully described and illustrated in the opening article of the current SUPPLEMENT, No. 1674. The latest development in foreign motor cars for railroads is described by the English correspondent of the SCIENTIFIC AMERICAN. This car is drawn by a kind of miniature locomotive, which can be used for other haulage within a limited scope. Prof. A. E. Watson contributes the tenth installment of his paper on the elements of electrical engineering. The subject discussed is controlling devices for railroad motors. Probably in the whole history of aeronautics no year has begun with such high hopes as 1908. A forecast is made of the probable progress which will be made. As our knowledge of the nature of radio-active phenomena has grown, we have reached the conviction that even radium, which is apparently unchangeable, cannot keep its activity forever, but that in course of time it is converted into another inactive product. Because radium would have disappeared long ago if it did not originate from something, it must be assumed that it is constantly formed afresh. Otto Hahn endeavors to trace the originating substance in an article which he entitles "The Mother Substance of Radium." "Sight in the Lower Animals" is the title of an article which gives much curious information. The coal reserves of the United States are mapped and discussed.

The Government Flying Machine and Airship Bids.

It has been decided by the Board of Ordnance and Fortification not to require inventors of flying machines to show all the features of their inventions when submitting bids. Consequently, if there are any features which an inventor wishes to keep secret, he can do so by simply making a note to that effect. Bids will be received up to noon of February 1.

All the bids for a dirigible balloon were rejected, but a new set of specifications have been drawn up, and bids upon these will be received until February 15. The new specifications are practically the same as the old ones, the chief difference being that the speed required has been reduced from 30 to 14 miles an hour.

AN OPEN-AIR VENEER MACHINE.

Many people who cannot grasp the significance of statistics can obtain a very definite idea from a graphic illustration. The steam-driven veneer slicer shows one of the machines which are "eating up" our forests. This great veneer wheel measures thirty-six feet in diameter, and weighs one hundred and seventy tons. The knives used in cutting the veneer are eleven feet long; and the machine has a daily capacity of 100,000 feet. It is driven from its outer rim by gear teeth meshing with a pinion on the engine shaft. The plant is at work at Winston-Salem, N. C., in the open air.

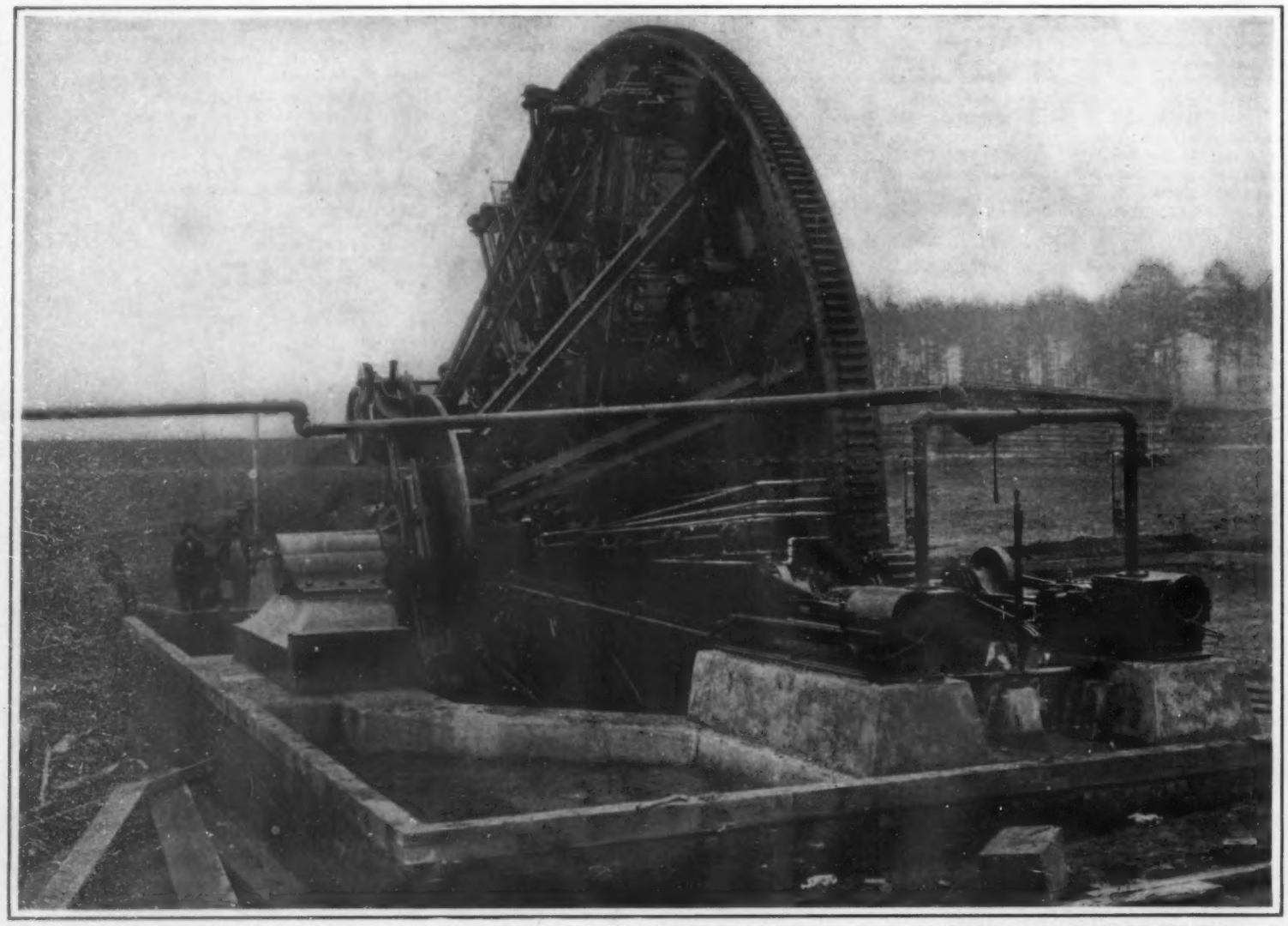
HOW OUR MEASURES OF LENGTH ARE TESTED.

BY HERBERT T. WADE.

Ordinary measures of length, such as the foot rule or yard stick, are made and divided to the exact scale of accurate standards; these standards being in turn derived from certain official ones. The parent standard—in France—is a metal bar marked with transverse lines. This bar at a certain temperature is the standard of distance accepted by the entire scientific and a large part of the commercial world. All of the measures of length used in science and industry are now referred to the International Prototype Meter, a platinum-iridium bar of X cross section preserved at the International Bureau of Weights and Measures at Sevres near Paris. Whether the measurement be made with a steel tape 200 feet in length or a four-meter metal bar, as in the case of the base line of a geodetic survey, or whether it involve such minute quantities as the wave length of light, ultimately it is necessary to go back to this standard bar. If the measures are of a country using the metric system, the comparison, or rather the series of comparisons, can be direct, but in the case of such countries as the United States, it is necessary to derive the customary measures from a metric national standard, making use of a legalized ratio. Accordingly, from the United States national standard, a meter bar, it is necessary to take 91.44 centimeters in order to have a legal yard. Thus while our ordinary measures are purely English, yet for their exact value they must be referred to meter bars made at the International Bureau. This of course does not imply that the United States is on a metric basis, but merely that it depends upon the best and most permanent standards.

In 1890 the United States, which had been a party to the Metric Convention of 1875, received from the Bureau two meter bars known as numbers 21 and 27, adopting the latter as the national standard. Now, the construction of such standards as these represents the work of the Bureau; and in addition to such comparisons from time to time, it is constantly working on other matters affecting standard length. Typical of this is the recent study of a nickel-steel alloy known as invar, which with a very small coefficient of expansion with temperature has been found available as a material for standards, and particularly for the wires or tapes used in measuring the base lines of geodetic surveys.

The instruments employed for the comparison of standards of linear measure are called comparators. The comparator designed primarily for studying the expansion of standards by comparing two meter bars at the same or different temperatures consists of two masonry piers, which go down on independent foundations into the ground, and are surmounted by heavy iron castings which carry two micrometer microscopes, the whole being arranged so that the microscopes are just one meter distant from one another. The piers and caps protected by wood and other non-conductors of heat can be seen in the illustration, and the floor is not in contact with the piers, so that no vibration, as that caused by the movements of the observer, can be communicated to them. The micrometer microscopes are of the ordinary type used for such work, and consist of compound microscopes in whose focal plane there is a system of cross hairs carried on a frame, to which a horizontal motion can be given by a screw with a divided head. By making the thread sufficiently fine and using a vernier to read the divisions of the head, it is possible to measure with great precision the movement of the cross hairs over any minute distance, as between the marks limiting distances of two standard bars, it being understood, of course, that the most precise standards of length are of the line type, as distinguished from end standards. Between the piers will be noticed a heavy casting carrying a carriage, on which are mounted two metal tanks or troughs, which can be moved transversely to a line joining the two microscopes. In these tanks the standards to be compared are placed in shaved ice, or water may be admitted to a surrounding jacket, so as to keep the temperature at any desired point. The temperature of melting ice, or zero degrees Centigrade, is the standard or correct temperature for the international meter, and other standards must be compared to it at that temperature. The water in the trough can of course be maintained at any desired temperature, and by means of paddles driven by electric motors it is kept in circulation. Carefully calibrated thermometers placed near the standards enable the temperature to be measured with great precision, and these are read through microscopes placed above the tank and to be seen in the illustration. The micrometer microscope through which the observer is looking is focused on the fine line traced on the surface of the bar to denote the limiting distance, and a series of settings and readings is made. A second standard in the other trough is then brought into precisely the same position under the microscopes, and the difference in length is measured by the micrometer microscope. A similar proceeding of course takes place at the opposite end of the standard. Keeping one standard at a fixed temperature, and varying the temperature of the other, enables a determination to be made of the expansion, which is of course one of the most essential constants of a standard bar that must be used for comparisons. For measures of length longer than a meter, or in particular for the four-meter bars used in measuring a base line, a special form of comparator is employed. The base line of a geodetic survey is a distance laid off on a level piece of ground, and measured with the highest precision possible, as it forms the initial measure on which is built up a network of triangles from which it is possible to compute distances of great length, such as an arc of the earth's surface. The special comparator for standardizing the geodetic bars can be used with bars either one, two, three, or four meters in length, and the expansion can be studied with as much care as in the case of the ordinary meter standards. This comparator consists of a series of five micrometer microscopes, ranged in line and mounted on separate masonry pillars. In front of them is a trough similar to that in the comparator just described, and also mounted on wheels. A standard meter is taken and adjusted, so that one of its lines is beneath the end microscope. The second microscope is adjusted on the line at the other extremity, and the standard is then moved along so that the first line comes under the second microscope, and the third microscope is duly adjusted. In

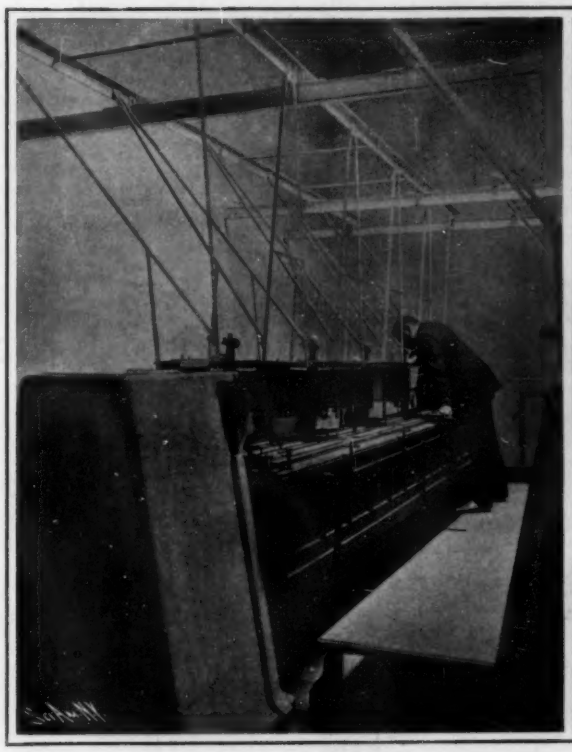


The Wheel Has a Diameter of 36 Feet and Weighs 170 Tons. The Cutting Knives are 11 Feet Long and the Daily Capacity is Nearly 100,000 Feet.

AN OPEN-AIR VENEER MACHINE.

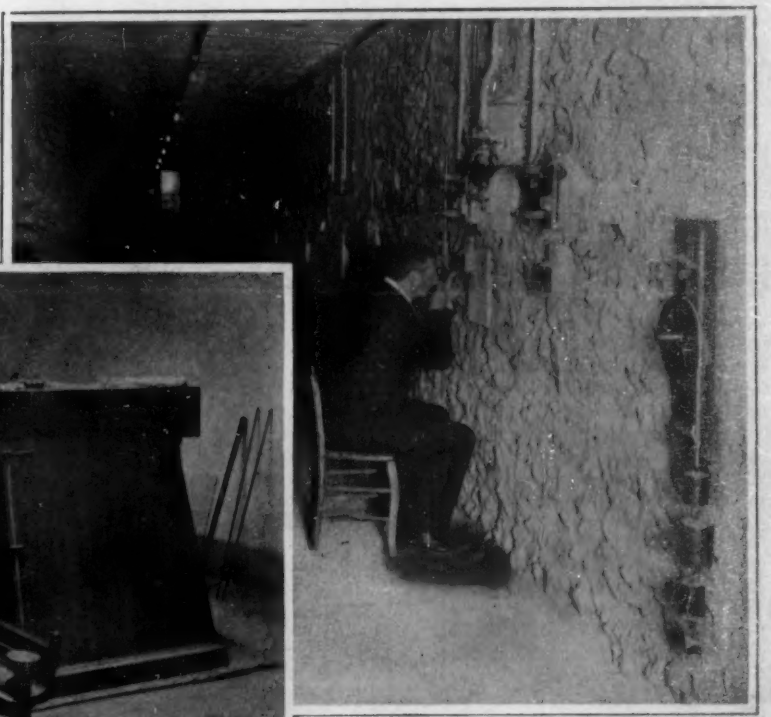
this way the various meter divisions are laid off, and the bar under test determined. By changing the temperature of the bar, and noting the difference in length as indicated by the microscopes at the end, or by two others mounted on similar pedestals in a line parallel to the five already mentioned, the coefficient of expansion of the particular bar under test can be obtained, and this of course must be used when a measurement is made in the field. To use such a bar to the highest advantage requires what is in short a temporary comparator with reading microscopes, but two or more bars can be placed end to end on tripods and carefully leveled and adjusted. The various metal bars used in geodetic surveys are most carefully constructed and tested, and numerous comparisons with the metric standards are made either before or after their use in the field, or often both. Consequently, all geodetic measurements throughout the world are made on the same basis, and the unit employed is the International Meter.

A more rapid method than employing a bar has been found to be the use of steel tapes or wires stretched by a certain constant weight. This method has been employed considerably, and when M. Guillaume of the Bureau International found that an alloy of nickel and steel was available where the effects of temperature were a minimum, it seemed at once desirable to make experiments with a view to its use for such geodetic measures as well as for bars and other standards. Accordingly, such wires were made, and have been undergoing test for several years. They are tested in an underground passage in the Bureau, where a constant temperature can be maintained, and imbedded in the masonry wall are a number of permanent marks that have been laid off accurately from a four-meter standard of invar. The standard distance so taken is 24 meters, this being selected as a multiple of four meters, the length of the ordinary geodetic bars, and with the wires stretched over pulleys as indicated in the illustration, it is possible to determine their elasticity, expansion, and other properties, the permanent marks making comparison at any time a simple matter. Another illustration shows the actual use of an invar wire in a field test, and indicates the simplicity of the apparatus and the ease with which it can be worked. The tripods at the ends carry the pulleys over which the wire is stretched, while the intermediate ones have a point on their heads, and a plumb line enabling this point to be marked on the ground or on a suitable stone. A divided scale is attached to the measuring wire at its extremities, so that an accurate reading as respects the point on the tripod head can be made. Keeping one of the marking tripods in position, and moving the other as well as the supporting tripods and wire, a base line of considerable length can be measured with speed and accuracy. Thus, while the accuracy is less than with the more cumbrous bar apparatus, it is often compensated for by the increased distance measured. An interesting and recent application of these invar wires was when a base was measured in the Simplon tunnel, affording a new check on the

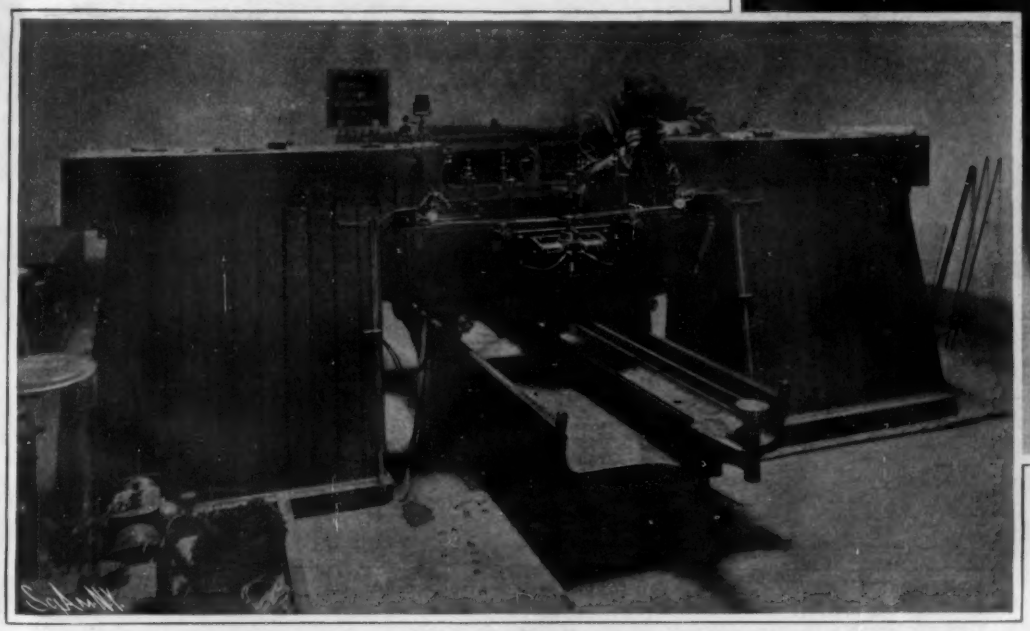


Measuring the 4-Meter Bars Used as Base by Surveyors.

Comparing End Standards for Engineers' Measurements.



Testing a Wire for Survey Work.



The Comparator in Which Standard Meters Are Tested and Compared.

The Use of an Invar Wire; Obtaining a Base for a Geodetic Survey.

HOW OUR MEASURES ARE TESTED.

Swiss and Italian surveys. As a contrast from the geodetic measures, are small end standards or test pieces for use in mechanical engineering and the machine shop. These are compared in the Hartmann comparator. This consists of a steel bed upon which are two bases, one of which is fixed, while the other can be placed at any desired distance. Through one of these bases passes a micrometer screw working in a thread, and having a solid head which is supplied with a pulley, over which pass the cords connecting with the mechanism, and ten long arms each carrying at its extremity a marking point that comes in contact with the paper on the registering drum. Between the two bases is a carrying device in which are placed the two standards to be compared, and these are automatically put in position alternately between the end of the screw and the terminal piece on the other base. As the screw is brought into contact with the pieces being compared, the registering points mark on the recording sheet, and from the mean of the readings the difference in the length of the two pieces is ascertained. This instrument has given remarkably good results, and is one of the most practical instruments of the Bureau.

The instruments described above represent but a few of the many comparators, dividing engines, thermometric apparatus, etc., that go to make up the equipment of the International Bureau, and are used in constructing and testing measures of length. With them must also be mentioned the wonderful optical apparatus of Michelson, that enables the standard meter to be determined in terms of the wave length of light of fixed position in the spectrum. By the principle of interference it is possible to measure a given distance with the wave length of light as a unit, and with this apparatus Michelson and Perot and Fabry have found exact values for the standard of length, so that a new meter could be constructed at any time by one well versed in the practical work of metrology.

HOW WE KNOW THAT THE EARTH ROTATES.

Fundamental to the accepted astronomical system is the doctrine of the diurnal rotation of the earth. This view, supported as it is by the unequivocal and undivided testimony of all those who have the right to speak, is nevertheless contrary to the appearance of things—perhaps as much so to-day as ever. The sun, moon, and stars do certainly seem to move across the sky. At first blush, it would seem as if a semi-rotation of the earth would be sufficient to put us where we would have no further excuse for not falling off. These objections to the theory of the axial rotation of the earth can certainly be answered, and in a way, too, to convince the untrained mind that they form no real obstacles to a belief in terrestrial rotation. But the mere removal of obstacles, while a very necessary preliminary matter, has nothing very compelling about it, and if this were all that could be said, one would be at liberty to believe or not. There is, however, an enormous mass of evidence, accumulated during the past few centuries through the strenuous and sustained efforts of astronomers, which confirms rotation and refutes fixity. No capable investigator has examined this evidence and remained unconvinced. At the same time, it must be said that the proof cannot be presented in full to the lay mind. And as to proof from direct observation, no one has stood off at some external point and become the actual observer of the rotating globe of the earth.

On the other hand, this phenomenon is not incapable of ocular presentation through its effects—through such effects, too, as it would be difficult to account for on other grounds. Before passing on to a consideration of such demonstrations, it may be well to devote a word or two to what might seem a very promising method. If a heavy object be dropped a considerable distance, say a vertical mile, the earth might be expected to carry its own surface a marked distance to the east during the progress of the descent. In fact, it would require about 18 seconds to accomplish this fall. At the latitude of New York city, the earth is rotating at the surface velocity of approximately 1,100 feet per second. Consequently, the point on the surface determined by a plumb line as immediately below the original position of the object would be carried eastward about $18 \times 1{,}100$ feet during the fall. The object would, accordingly, complete its fall about 3.7 miles westward of the point determined by the plumb line, if there were no other influences at work. It must be remembered, however, that the object at the moment of beginning its fall had acquired from the earth an eastward velocity equal to that of the earth. The only influence capable of effecting this is the horizontal resistance of the air. But the atmosphere itself is accompanying the earth at the same velocity, and so is able to afford no horizontal retardation. In fact, when we consider that in reality the object at the beginning of its fall had not only an equal velocity to that of the surface of the earth, but a greater one, due to the circumstance that its radial distance from the axis of rotation was one mile greater than that of the surface, we might expect it to reach the ground to the *eastward*—even notwithstanding the fact that it was continually falling into a slower-moving atmosphere. The consideration that this would yield a very small deviation, together with the difficulty of making proper allowance for the atmospheric retardation, would seem to reduce this method to one of limited application.

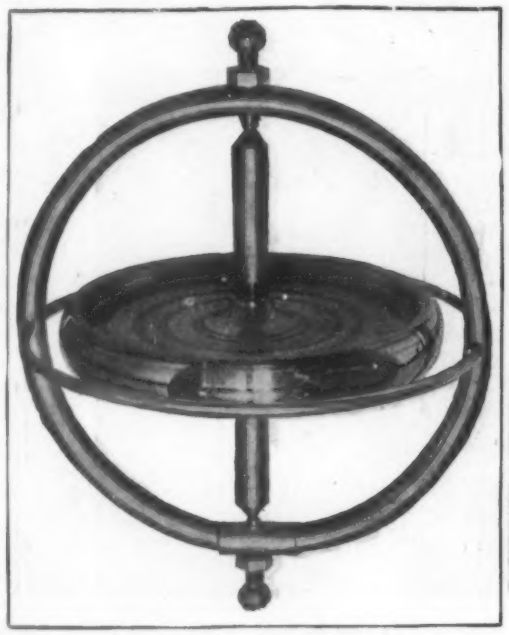


Fig. 1.—A Simple Form of Gyroscope.

Another method, and one free from serious difficulty, involves the use of the gyroscope. This beautiful experimental demonstration of the axial rotation of the earth was apparently first proposed by Edward Sang in a paper read before the Royal Scottish Society of Arts in 1836. The same method was independently brought forward and actually used by Foucault about 1855. The experiment depends for its success upon the fact that a rapidly-rotating disk exerts considerable resistance to any angular displacement of its plane of rotation. Anyone may convince himself of this by setting in swift rotation the simple form of gyroscope shown in Fig. 1. If, while the disk is rapidly rotating, the frame be held in the hand and moved about in such manner as not to cause any angular deviation of the axis of rotation, there will be experienced little or no resistance. But, if an attempt be made to change sharply the direction of the axis, a distinct resistance will be felt. Now, if a large and heavy gyroscope—mounted as shown in Fig. 2, so as to have its axis free to assume all directions—be maintained in rapid rotation, its axis may be relied on to persist in its original direction, although the whole may be made to go through all sorts of changes. This persistence of the axis of rotation is the point that must be kept in mind all through. Consider now the direction indicated by *A B* in Fig. 3. This may be taken to represent the direction of the axis of the gyroscope at the beginning of the experiment. When rotation of the earth has carried the gyroscope eastward, the supporting frame being fixed relatively to the surface of the earth, the axis will maintain its original direction, and we shall find, upon examining Fig. 4, that it has now, so far as an observer upon the earth would judge (his judgment being based upon relative positions of surrounding objects, meridians, etc.), made a partial rotation in the direction of the hands of a clock. In reality, as is plain to us who are removed from both objects, the earth has turned underneath the gyroscope disk from east to west, that is, contrary to the hands of a clock. However, the gyroscopic axis will not appear to a terrestrial observer to be revolving in a plane, but on a surface of a cone. This is the ocular method of demonstration of Sang and Foucault.

Fig. 2.—A Three-Axis Electrical Gyroscope.

Fig. 3.—Initial Position of Gyroscope Axis.

Fig. 4.—Gyroscope Axis After Partial Rotation of the Earth.

Now, Foucault gave still another method of showing visibly the diurnal rotation of the earth. In this experiment, a property of the pendulum, similar to the one utilized in the case of the gyroscope, is taken advantage of. If a pendulum be supported freely, that is, by the equivalent of a universal joint, and then set in vibration through a considerable arc, it will be found to manifest, analogously to the gyroscope, a distinct tendency to swing always in the same plane. An experiment in confirmation of this persistence of the plane of oscillation may easily be made. Attach a heavy bob to a silk thread three or four feet long, thus making a pendulum. Holding the one end between the fingers of one hand, let it be set in steady motion through a considerable arc. After making sure that the vibrations are proceeding in an even manner, it will be found that the hand may twist the thread without affecting the plane of oscillation. Of course, with a simple thread, care must be taken that the twisting does not proceed far enough to produce a torsion through its entire length. If a swivel or universal joint be used, this caution may be disregarded. Of course, this twisting at the point of support is equivalent to rotation of the room. Now, this latter is just what occurs when the pendulum is resorted to in order to manifest the axial rotation of the earth. The earth rotates, or turns, under the pendulum. But the pendulum does not follow this turning movement of the earth, but maintains its plane of oscillation continually parallel with itself. This may be understood by referring back to Figs. 3 and 4, where *A B* and *A′ B′* may be taken as indicating the direction of the swing of the pendulum bob at different stages of the earth's rotation. This experiment was carried out on a large scale by Foucault in the Pantheon at Paris in 1852. The length of his pendulum was about 220 feet, and the weight of the brass bob about 62 pounds. Schwerd repeated the experiment in the cathedral at Spire. The celebrated cathedral at Cologne was also utilized by Gathe for the same purpose. The experiment is to be repeated in the Chapel of Columbia University in New York city very shortly.

Transatlantic Wireless Telephoning.

Wide newspaper publicity has been given to a report that Poulsen will within a few weeks establish a wireless telephone communication between Ireland and America. This report follows on the heels of one that wireless telephone messages have spanned the 240 miles dividing Berlin and Copenhagen—in itself an exceptional accomplishment, if true. Prof. Pupin, of Columbia University, says: "Prof. Poulsen's invention of the continuous oscillator makes wireless telephony possible beyond a doubt. But the distance over which communication can be established will always be limited, and he will never be able to telephone across the Atlantic or over any other area of the same size. In telegraphy the whole of the power is available for signaling, while in telephony this only holds true for a small fraction of the power. So it does not seem likely that wireless telephony will ever cover nearly the distance that wireless telegraphy can. To do the same work, telephony would require a hundred times the power needed for telegraphy.

Joints in a cupola can be pointed up with finely ground chrome ore. This material is largely used in constructing the hearths of certain steel melting furnaces and can be obtained from foundry supply houses. It will be necessary to use a very small amount of clay in the mixture to render it plastic. In lining an ordinary cupola the joints should be made as tight as practicable, the bricks being dipped in a thin clay wash before they are placed in position.

A FAMOUS TAXIDERMIST AND HIS METHODS.

BY HAROLD J. SHEPSTONE.

Of the European taxidermists, none has earned a greater reputation as a successful mounter of the bigger beasts than Mr. F. J. Umlauff, of Hamburg. Indeed, he can lay claim to several records in this

PHOTOGRAPH OF A GORILLA TAKEN IMMEDIATELY AFTER IT WAS SHOT IN CENTRAL AFRICA.

profession, having mounted the largest gorilla ever shot, and also the biggest sea elephant ever killed.

Just now, Mr. Umlauff is engaged in mounting a host of animals for one of the Lamas of Thibet. This collection will include all kinds of Indian animals, such as the elephant, the monkey, the tiger, and various kinds of birds. There will also be a giraffe in the collection, as well as representations of snakes and fishes. In the mounting of these beasts there will be no attempt to produce artistic groups. Each animal will be mounted separately, and in sections, so that the transportation difficulties in Thibet can be the better surmounted. These animals are destined for the sacred city of Lhasa, which fact must assuredly be accounted as a sign of progress so far as this hitherto isolated and closed country is concerned.

When the writer was in Hamburg a few weeks ago he called upon Mr. Umlauff, and obtained some interesting information from him as to his work as a mounter of large animals. Probably no taxidermist has been more successful in the mounting of big apes than Mr. Umlauff. In his workshop I was shown a gorilla just completed that stood over five feet in height, while modelers were busy upon the carcasses of two others almost as large. The skins of these animals are supplied to him by Mr. H. Paschen, a hunter, who has resided in Central Africa for years. He seems to find little difficulty in supplying the skins, while Mr. Umlauff apparently finds it comparatively easy to dispose of the stuffed specimens as soon as finished. They are sold, of course, to museums in all parts of the world.

It was Mr. Paschen who killed the record gorilla whose stuffed skin is now to be seen in the Hon. Walter Rothschild's museum at Tring, Hertfordshire, England. It is without question the finest mounted specimen of the big ape in the world. It was killed by Mr. Paschen during a hunting trip in the Cameroons. He was strolling one afternoon alone a little way from his camp, when a band of natives suddenly confronted him. They told him that a "big monkey" had made its appearance in their neighborhood, of which they were afraid. Mr. Paschen subsequently set out to find "the monkey," accompanied by some eighty natives. After about fifteen minutes' walk they came to a dense and swampy thicket, where the natives said the beast was hidden.' At last the animal was discovered hiding in a tree, so situated that no one could get at it.

The daring hunter at once took out his bush knife, and after considerable trouble managed to cut a path to the foot of the tree. Its curiosity aroused, the gorilla looked down through the leaves, but at that moment the hunter's gun was heard, and the huge beast received an ugly wound in the jaw. It fell head first out of its perch, and caught hold of the branches before it reached the bottom. But a second shot, well directed, brought the monster to the ground at the very feet of the slayer. It was not only a giant, but a magnificent specimen of its class. The skin was beautiful and the teeth perfect. Twelve men carried it back to the village—no easy task, as the monster turned the scale at 500 pounds. The animal was then skinned. This and the beast's bones were embalmed and sent to Europe. An account of the method pursued in the mounting of the gorilla will give an idea of the general system followed at this interesting establishment.

On the receipt of the skin and bones, numerous measurements were taken. Then a clay model was made to guide the taxidermist in his task. The skin was then cleaned and tanned, a process which occupied several weeks. The real labor in connection with the mounting was that involved in building a suitable framework, or "manikin," to receive the skin. To accomplish this, a wooden skeleton was made and firmly bolted to a stout platform. This was padded with excelsior, on top of which was laid a thick layer of modeling clay. This latter was a close copy of the real animal on a slightly smaller scale, to insure a perfect fit of the skin. When the skin was stretched and stitched on the clay model, the task was by no means finished. Here and there little bald places had to be covered with artificial hair; a few parts of the body required a little coloring to render the whole harmonious, while the ears and great open mouth demanded considerable manipulation to give the animal a lifelike appearance. This huge beast, it may be stated, stands 5 feet 5 inches high and measures over eight feet from finger to finger.

It takes from four to six months to mount a gorilla, the time depending upon the size of the animal and whether there is much to do in the way of "trimming." The art of taxidermy is not the mere stuffing of an animal, but in giving it a lifelike appearance. Curiously enough, the arranging of the hair of a gorilla calls for a great deal of patience. In traveling and during the process of tanning a lot of the hairs come out, and these have to be replaced by artificial ones. They must be of the right color and length and inserted correctly. The hair of a gorilla grows on its arms in two directions, for the hairs on the lower arm point backward toward the elbow, and from the shoulder to the elbow they point downward. When the tropical rain descends in torrents, the gorilla sits down and folds its arms over its chest; the rain runs off the shoulders and down the arms, shooting off at the elbows; the arms therefore serve as a thatch to keep the body of the creature dry.

An interesting taxidermic feat in process of completion at the Umlauff establishment at the time of the writer's visit was the mounting of a large Indian elephant. This animal was useless as an inhabitant of the zoo, having gone mad, and was accordingly purchased by the taxidermist. It was then strangled, and by killing the beast in this way the hide was practically undamaged. The skinning of the great brute occupied a fortnight, and several gallons of embalming fluid were injected into the veins to render the work more pleasant. Then came the tanning of the skin and the cleaning of the bones. After this, of course, comes the mounting, which portion of the work had not been put in hand at the time of the writer's visit. Needless to add, a particularly large and strong frame is demanded to carry such a gigantic hide as that of an elephant. The fact is, a taxidermist who mounts giant beasts of this description needs to be a carpenter and a blacksmith as well as a modeler and an artist. There are few professions demanding so many qualifications as that of the successful and artistic mounter of the bigger beasts.

The Wireless Telegraph of the Togo Negroes.

A German colonial official writing from German East Africa says: "During a journey in Togo I noticed particular bell-like tones coming from a distance. I asked my 'boy' what that meant. He said that it was the 'ehu,' a remarkable instrument consisting of two wrought-iron cow-bells, one large, the other small, which are welded to a common handle and struck with a stick. According as the tones are at shorter or longer intervals apart, words and sentences are formed, and these are thus conveyed from village to village. Almost every native in the party seemed to understand the ehu language. As the sounds were sent out far into the distance, the boy said smilingly: 'Sir, that is about you; the ehu has said: "The white man comes. He has no soldiers. He is going to Woga."'"

It is, however, questionable whether the instrument conveys words and sentences as such; for this would imply a written language. It could, however, be used to convey ideas, just as does one form of the deaf and dumb sign language.

GORILLA FROM THE CAMEROONS. HEIGHT, 5 FEET 5 INCHES. IT TOOK FOUR MONTHS TO MOUNT THE ANIMAL.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

CIGAR CUTTER AND LIGHTER.—A. Von Kaspis, Pittsfield, Mass. The more particular object in this instance is to produce a combination instrument having the properties of a cutter and lighter, and operated for both of its general purposes by a single slide actuated by a pressure button. It further relates to a type of casing for housing the batteries employed in connection with the cutter and lighter.

MERCURIAL THERMOSTATIC CIRCUIT-CLOSER.—F. Cossor, 12 Clerkenwell Green, London, E. C., England. In mercurial thermostatic circuit-closers as usually constructed the evil effects of oxidation and corrosion are common. Mr. Cossor's improvements overcome these defects either partially or wholly by the closer being constituted by a body of mercury having an exposed surface or surfaces of very small area, the mercury being contained in a chamber of such form that after each closure of the circuit a fresh mercurial surface may become exposed.

ELECTRIC SAFETY SYSTEM.—H. A. Hill, Delafield, Wis. The invention comprises more particularly, electrically operated mechanism employed for the purpose of stopping trains when the same arrive in the proximity of other trains, or upon some part of the road upon which travel is rendered dangerous because of the condition thereof.

Of Interest to Farmers.

CORN-HUSKING MACHINE.—J. Hettrich, Grand Island, Neb. The invention is especially adapted for use in the corn harvester in a former patent granted to Mr. Hettrich. The snapped ears are delivered on the upper end of the husking rollers, and slide by gravity toward the lower end. Means engage the husk, while the plates act to loosen the husk on the ears. A spring permits the plates to yield upwardly when engaging a large ear, while retaining them in proper position at all times to engage the smaller ears.

HAY-STACKER.—C. C. Denenny, Felton, Minn. In the operation of the stacker, when a sufficient amount of hay is placed on the fork, traction is exerted to lift the fork with its load off the ground, and the load is discharged onto the stack. The stacker is provided with wheels near its rear end for convenience in moving the same from place to place.

MACHINE FOR SHARPENING PLOW-SHARES, DISKS, ETC.—D. H. Sneed, Stonewall, Oklahoma. The shares are for use in sharpening plow shares, harrow disks, and the like, and for rolling out plates and training shoes. Motion is given to the shafts and the rolls or dies thereon, and by means of the eccentric operating upon the bearing frame the inventor is enabled to adjust the pressure on the dies instantly to any degree.

Of General Interest.

REVOLVING ORE-TANK.—A. J. Garver, Clarkston, Wash. In the present patent the invention relates to apparatus for working ores and more particularly to an arrangement for bringing the comminuted and roasted ore into thorough contact with a hot solution, as a step incidental to the extraction of metals from their ores.

FIRE-ESCAPE.—A. Reuter, New York, N. Y. The fire escape is attached near windows of dwellings. It is of the class which operate frictionally to allow a rope or cord to run down under the weight of the body. It operates efficiently to increase the resistance automatically with an increase of weight, so that an unusually heavy person will descend at substantially the same speed as a light one.

Hardware.

FASTENING FOR DOOR-KNOBS.—J. F. Smart, 4 Irving Place, Elmhurst, L. I. The object of the invention is to produce a fastener constructed of few parts, adapted to be assembled in a simple manner and without necessitating the employment of set screws or similar fasteners. In practice, such set screws are likely to work loose so that the knobs become disconnected from the door.

MITER-BOX.—C. C. Galentine, Redondo, Cal. The purpose here is to provide a miter-box reliable in use, and which may be quickly set for cutting any desired vertical or horizontal angle, it being so constructed that it is composed of a small number of parts, and may hence be manufactured economically.

CUTTING AND FACING TOOL.—W. S. Watson, Memphis, Tenn. The invention relates to the art of button making disclosed in the Letters Patent of the U. S., formerly granted to Mr. Watson, and in an application for an automatic button cutting and shaping machine previously filed by him. The object of the present invention is to provide a tool more especially designed for accurately cutting out the button from a shell and simultaneously facing the button.

Heating and Lighting.

SAFETY-VALVE.—J. H. Thiele, New York, N. Y. The more particular object of the invention is to produce a type of safety valve suitable for general use but of peculiar value in connection with steam and hot water heating plants. The valve, though capable of opening to various degrees, is nevertheless always either open or shut, and there can be no undesirable leakage or incidental escape of steam or water through the apparatus, except such as is called for by the general condition of pressure.

Household Utilities.

ADJUSTABLE SHADE OR CURTAIN HOLDER.—G. F. Sheerer, Columbus, Ohio. The invention relates to holders or brackets such as used for supporting the rollers of shades or curtains hung at windows. More specifically, it concerns the construction of an adjustable type of bracket for this purpose, employing a slot in which an adjustable bracket piece runs. The object is to simplify the construction and means for mounting the bracket piece in the slot.

CEREAL-DISH.—L. T. Kinert, Boise, Idaho. The dish is especially adapted for cereal foods which depend largely on crispness for their palatability. The cereal in the main supply compartment will be kept from the cream until it is desired to mix the same for immediate use and the dish will facilitate proper mixing of the cream and cereal to suit the taste.

Machines and Mechanical Devices.

WIRE-COATING MACHINE.—H. H. Webb, Yonkers, N. Y. Prior to this invention only one coating of plastic was applied to a wire at a time, which was given time to set before being firm enough to receive a second; it was also impractical to apply the entire thickness at once owing to inability to centrally envelop the wire. Mr. Webb overcomes these difficulties by successively covering the wire with two or more coats in the same machine, which coats may be of one and the same or different materials.

AUTOMATIC PAWL-OPERATING MECHANISM.—W. E. Waldron, New Castle, Pa. The mechanism is designed for use on pawl and ratchet devices employed for traveling cranes and other machinery and devices, and is arranged to hold the pawl out of engagement with the ratchet wheel when the latter turns forward, and to immediately swing the pawl into locking engagement with the ratchet wheel when the latter tends to turn in the reverse direction, thus holding the wheel against return movement.

RECORDER.—R. A. Wood, New York, N. Y. The object of the inventor is to provide a recorder, more especially designed for use on rolling mills and other machines, and arranged to accurately record the amount of material fed through the machine by the workmen and the time, thus giving a full and complete record of the operator's work during working hours.

HAND-LOOM.—Rose K. Lenox, New York, N. Y. The invention relates particularly to improvements in hand looms for weaving or fastening together bundles of hair for the formation of wigs; but it is equally well adapted for making fringe or the like, the object being to provide a machine operated manually to turn out very much more work than possible by the usual method of hand work.

VALVE MECHANISM.—L. J. Johnson, Terre Haute, Ind. The improvement relates to two-cycle gas engines, and its object is to provide a valve mechanism, more especially designed for two-cycle gas motors having two cylinders with a like amount of the combustible mixture, to insure uniform running of the motor.

Pertaining to Recreation.

PUZZLE.—W. H. Maltbie, Baltimore, Md. Mr. Maltbie provides in connection with a transpicuous body, an apertured diaphragm within the same together with a pound below the diaphragm and in alinement with the opening therein, the pound being adapted for reception of movable devices discharged from above the diaphragm through the opening therein, the puzzle consisting in securing the deposit of such devices in the pound when discharged through the opening in the diaphragm.

WAGON.—F. Weber, New York, N. Y. The improvement is in children's wagons, relating more especially to that type driven by the operation of a hand-lever. The object is to provide a construction in which the lever may be disconnected from the driving mechanism and used as an ordinary tongue for pulling and guiding the wagon; this changing of handle or lever from one position to the other being readily effected.

Pertaining to Vehicles.

HAND-TRUCK.—W. Wanee, Red Bluff, Cal. The object here is to provide a truck, more especially designed for the use of expressmen, porters, and others, and arranged to permit easy and convenient loading of the truck, box, or the like onto a wagon or a platform, and to allow of raising the truck up a step or two onto a sidewalk, for instance.

Designs.

DESIGN FOR A PEDESTAL AND JARDINIÈRE.—E. L. Collis, Cincinnati, Ohio. Included in this design are a flower pot, or jardinière proper, and a column or support for the same which has an enlarged base and top. Both pot and column have an ornamental form and are ornamented with elliptical, vertically arranged figures in dark color on a lighter ground.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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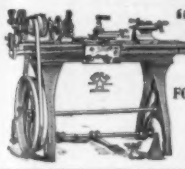

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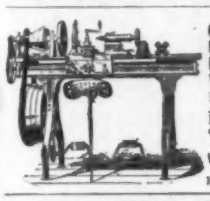

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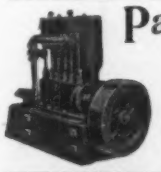

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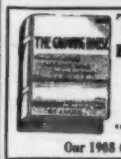

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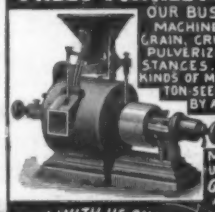

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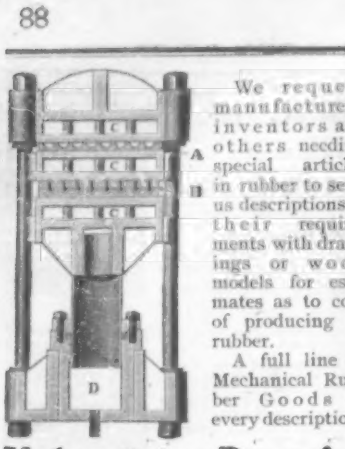

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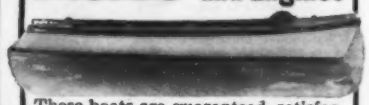

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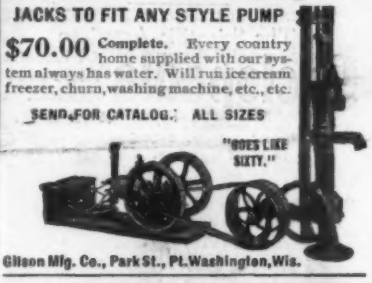

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